In the Technological Footprints of Urbanity: A Socio-political History of Water and Sanitation in Nairobi, 1899-2015

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ERKLÄRUNG ZUR DISSERTATION

Hiermit versichere ich an Eides statt, dass ich die vorliegende Arbeit selbstständig und nur unter Verwendung der angegebenen Quellen angefertigt habe. Alle wörtlichen und sinngemäßen Entlehnungen sind unter Angabe der Quelle kenntlich gemacht. Die Arbeit wurde bisher weder im In- noch im Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehorde vorgelegt.

Darmstadt, den 01.02. 2018 M.A. Jethron Ayumba Akala

DEDICATION

First and foremost, this thesis is dedicated to all friends and family I have lost through demise and to whom I couldn't directly pay my last respects because of the distance and undertaking of this work.

Secondly, to my teacher, mentor and doyen of Kenyan history, the late Prof. William .R. Ochieng'. You must be smiling from up there.

Lastly, to the future of HOT.

ABSTRACT

While History of Technology as a discipline has developed more strongly in the Global North, a huge lacuna exists in the Global South, particularly in Africa. In addition, the few texts that have given attention to the South have more often than not continued to bracket these localities and the experiences of its peoples as either a historical or lacking agency. The over-emphasis on the perspective of the colonizers rather than the colonized that is evident in most of the literature has led to inconclusive typologies common to many syntheses of Africa's past especially its urban experiences. In many instances, the dichotomous and a symmetrical analysis results into the African practices of the city being reduced to a colonial perception of disorder. To envision Africa's cities only in terms of their colonial and postcolonial relationships may preclude a fuller understanding of the multifaceted ways in which they have engaged with the larger world. Furthermore, most studies on technology and infrastructure to be particular have employed dominant paradigms like the theory of Large Technical Systems (LTSs) and propagated the imagination of most urban spaces within the lenses of the 'networked city model'. These theoretical frameworks have produced incomplete narratives that see the South as chaotic, disorderly and operating on the brink of collapse. It is this fact that has driven contemporary social science and technology studies to call for a departure from the 'old' to a new scholarship that acknowledges the localities in the South as not only 'sources for data' but also as 'sites for theorization in their own right'. What is needed in history of technology is a shift from focusing on 'origin and invention' to 'use, meaning and effect' so as to avoid the reproduction of knowledge that continues to 'privilege' the North. Towards the development of Global History of Technology, the gap needs to be bridged by giving attention to the historical particularities of the Global South rather than the South being approached as exceptional.

It is on this backdrop that this study of Nairobi was undertaken. Moving between the formal level of engineering and planning and the informal level of daily practice, the dissertation investigated how urban water and sanitation technologies were adopted, appropriated, and contested by various actors. Archival investigations in Nairobi, London and Oxford (UK) and oral accounts of users were employed and analyzed

qualitatively. By departing from the dominant LTS perspective, the study zeroes in on the role of users as participants in the making of the histories of the city and as non-passive recipients of migratory ideas and ideals, especially in the process of procuring their daily needs. Technical infrastructural artifacts are looked at as multilayered and possessing a powerful political and economic nature that determines their access and 'allocative' role. Nairobi's water and sanitation socio-spatial outlay was unbundled to reveal a quilt of a heterogeneous techno-scape.

Nairobi, like any city in the world has its urban materialities embodying aspirations of various actors but historically, its engineer sociologists continue to define both the characteristics of the technical artifact and the social universe in which they are to function. As a colonial city and an urban space, Nairobi was loaded with imprints of social differentiation, social control and domination and the post-colony has seen elitist ideals augmented in parallel with a rapidly expanding group of urban poor. However, much as infrastructure supply has for several years followed a variegated path, this study sought to push the boundaries beyond the conventional asymmetries of race, class and 'legal' versus 'illegal' as explained through the formal and informal binary that is common in Urban Studies. It is not enough to conclude that the deployment of key infrastructures adheres to racialized (later elitist or class) planning. Rather, the question of access is informed by many factors that include the political nature of artifacts themselves and people as non-passive recipients; the cost-recovery component of 'modern' infrastructure projects as juxtaposed to the socio-cultural constructs of water and sanitation provisioning. Nairobi in retrospect attains a techno-collage or patchwork of modalities of provisioning that affirms the heterogeneous nature of most urban spaces.

Furthermore, juxtaposed against the 'splintering urbanism' thesis, this work reverses the narrative by pointing out that the Global South cities have traditionally been fragmented and 'splintered' in terms of their socio-technical topologies. Nairobi for instance has from its foundation been marked by a quilt of different socio-technical arrangement of water and sanitation provision that combine both top-down approaches that are characterized by highly centralized municipal governance and bottom-linked modalities. These include shallow wells, boreholes, rain-water-harvesting, cesspits, and

pushcarts amongst others. There are also ‘mediative’ hybridized arrangements like the ‘spaghetti’ pipes and standpipes cum water kiosks. The centrality of some of these methods from below, as espoused in this study, has witnessed a process of streamlining. This is acknowledged by the utility companies through public-private partnerships that combine the large and the small to plug into the technological gaps existing especially in the informal settlements that are melting pots of both technological innovation and contestation. Heterogeneity and ‘decentered’ or devolved small scale modalities of provision have been and will always remain a permanent marker of most cities as their history goes hand in glove with that of the cities themselves. Nairobi’s checkered sociotechnical outlay is as old as the city itself.

Perhaps, as the writing of a Global History of Technology takes center stage, future scholarship needs to focus more on the multilayered nature of human and knowledge flows that go beyond the North-South binary to encompass South-North, South-North-South, South-South amongst many other shifts and counter-shifts, as we grapple with the challenge of knowledge production on histories of technology that is highly representative.

ZUSAMMENFASSUNG

Während die Technikgeschichte als wissenschaftliche Disziplin im Globalen Norden stark vorangetrieben worden ist, besteht für den Globalen Süden, insbesondere Afrika, in dieser Hinsicht eine große Lücke. Zudem stellen die wenigen Texte zum Thema, die dem Süden überhaupt Beachtung schenken, die lokalen Eigenheiten und Erfahrungen der Menschen dort entweder als ahistorisch dar oder klammern sie aufgrund vermeintlich fehlender Handlungsmacht aus. Durch die Bevorzugung der Perspektive der Kolonialisten gegenüber jener der Kolonisierten, die den Großteil der Literatur offenkundig prägt, sind in Bezug auf die Vergangenheit Afrikas, insbesondere die dortigen städtischen Erfahrungen, meistens unvollständige und einseitige Darstellungen entstanden. In vielen Fällen hat diese dichotome und asymmetrische Analyse von urbanen Praktiken in Afrika dazu geführt, dass sie in der reduzierten kolonialen Wahrnehmung schlicht als Unordnung erscheinen.

Eine solche Auffassung von afrikanischen Städten, d. h. ausschließlich im Hinblick auf ihre kolonialen und postkolonialen Beziehungen, riskiert aber, dass die vielfältigen Verknüpfungen mit der restlichen Welt nicht umfassend berücksichtigt und verstanden werden. So werden in den meisten Studien zur Technologie und Infrastruktur beispielsweise dominante Paradigmen, wie die Theorie von Large Technical Systems (LTS), zugrunde gelegt und urbane Räume werden durch die Linse des "Networked City"-Modells betrachtet. Durch diese theoretischen Rahmungen sind unvollständige Narrative entstanden, denen zufolge der Globale Süden chaotisch, regellos und am Rande des Kollapses agiert. Dies wiederum hat dazu geführt, dass die zeitgenössischen Sozialwissenschaften und die sog. Sceince and Technology Studies (STS) von einer Abkehr der "alten" zugunsten einer neuen Wissenschaft aufrufen, in der Orte des Südens nicht lediglich als "Datenquellen" betrachtet werden, sondern als eigenständige Orte zur Theoriebildung. Was die Technikgeschichte also braucht, ist eine Verschiebung des Schwerpunkts von Ursprung und Erfindung hin zu Nutzung, Bedeutung und Wirkung. Dadurch könnte verhindert werden, dass nur Wissen reproduziert wird, das fortlaufend den Norden privilegiert. Wenn auf eine Globale Technikgeschichte hingearbeitet werden soll, muss diese Lücke geschlossen werden,

indem den historischen Eigenheiten des globalen Südens ernsthaft Aufmerksamkeit geschenkt wird, anstatt ihn immer als exotische Ausnahme zu begreifen.

Die vorliegende Studie über Nairobi wurde vor dem oben skizzierten Hintergrund durchgeführt. Die Dissertation untersucht, wie städtische Wasser- und Sanitärtechnologien durch verschiedene Akteure übernommen, angepasst und infrage gestellt wurden. Dabei berücksichtigt sie sowohl die formalen Ebenen des Ingenieurswesens und der Stadtplanung als auch die informale Ebene der alltäglichen Praxis. In Nairobi, London und Oxford fanden Archivrecherchen statt und es wurden quantitative Befragungen von Nutzern durchgeführt und ausgewertet. Durch die Abkehr von der dominanten LTS-Perspektive fokussiert die Studie auf die Rolle der Nutzer als nicht-passive Teilnehmer an der Geschichtsschreibung der Stadt, insbesondere bei der Erledigung ihrer täglichen Bedürfnisse. Technische Artefakte und Infrastrukturen werden in diesem Zusammenhang als vielschichtig und von inhärenter politischer und wirtschaftlicher Natur angesehen, da der Zugang zu ihnen sowie ihre allokative Rolle festgelegt sind. Der sozialräumliche Aufbau der Wasser- und Sanitärversorgung in Nairobi wird entflochten und hat einen Flickenteppich heterogener Techniklandschaften entfaltet.

Wie jede Stadt verfügt Nairobi über eine lebendige urbane Materialität, die von den Ambitionen und Hoffnungen verschiedener Akteure bestimmt wird. Historisch gesehen jedoch definierten fortlaufend die Bauingenieure und Planer der Stadt die Merkmale der technischen Artefakte und das soziale Universum, in dem sie funktionieren. Als Kolonialstadt und urbaner Raum wurde (und wird) Nairobi durch soziale Differenzierung, soziale Kontrolle und Herrschaft geprägt. Außerdem wurden elitäre Ideale in der postkolonialen Zeit stark befördert, während parallel eine immer schneller wachsende Gruppe an Menschen in städtischer Armut lebt. Ebenso wie ein Großteil der Infrastrukturversorgung seit einigen Jahren unterschiedliche Wege geht, versucht diese Studie die Grenzen über die konventionellen Asymmetrien zwischen den Rassen, Klassen und Kategorien von ‘legal’ und ‘illegal’ durchzubrechen. Dieses formale und informale binäre System wird zur Erklärung der meisten städtischen Räume herangezogen. Es reicht jedoch nicht, zu dem Schluss zu kommen, dass der Ausbau der grundlegenden Infrastruktur einer rassifizierten (später elitären oder nach Klassen

strukturierten) Städteplanung folgt. Die Frage des Zugangs zur Infrastruktur wird von vielen Faktoren bestimmt, wozu u. a. auch zählen: die politische Natur der Artefakte selbst, die Bewohner als nicht-passive Empfänger und die Kostendeckung "moderner" Infrastrukturprojekte, wie sie den soziokulturellen Konstrukten der Wasser- und Sanitärversorgung gegenübergestellt wird. Rückblickend wurde in Nairobi eine Technik-Collage aus Versorgungsmodi verwirklicht, die die heterogene Natur der meisten städtischen Räume untermauert.

Darüber hinaus kehrt diese Arbeit das Narrativ vom "zersplitternden Urbanismus" (*splintering urbanism*) um, indem darauf verwiesen wird, dass Städte des Globalen Südens, und vielleicht auch des Nordens, in Bezug auf ihre soziotechnologische Topologie traditionell schon immer fragmentiert und "zersplittert" waren. So wird Nairobi beispielsweise durch ein Flickwerk verschiedener soziotechnologischer Übereinkünfte zur Wasser- und Sanitärversorgung geprägt, wobei Top-down-Ansätze, die durch eine höchst zentralisierte kommunale Verwaltung gekennzeichnet sind, und Bottom-up-Verfahrensweisen kombiniert werden. Zu Letzteren gehören u. a. Brunnen, Bohrlöcher, das Sammeln von Regenwasser, Klärgruben und Schubkarren. Zudem gibt es hybridisierte Vorrichtungen wie "Spaghetti"-Rohrleitungen und Steigrohre oder Wasserkioske. Die Bedeutung dieser Bottom-up-Methoden, die in dieser Studie verfochten werden, ist inzwischen von Versorgungsunternehmen durch öffentlich-private Partnerschaften anerkannt und optimiert worden. So wurden die großen und kleinen Lösungen kombiniert, um die technologischen Lücken zu schließen, die insbesondere in informellen Siedlungen bestehen, welche zugleich Schmelzpunkte technologischer Innovation und ihrer Anfechtung sind. Die Heterogenität und Dezentralität dieser kleinformatigen Versorgungsmodalitäten waren schon immer ein festes Kennzeichen der meisten Städte im Globalen Süden. Ihre Entwicklung ging immer Hand in Hand mit der Entwicklung der Städte selbst. Die schachbrettartige soziotechnologische Gestaltung von Nairobi ist so alt wie die Stadt selbst.

Je stärker sich die Technikgeschichte globalen Themen widmet, umso mehr wird die zukünftige Wissenschaft sich vielleicht auf die vielschichtige Natur von Menschenströmen und Wissensflüssen konzentrieren müssen. Denn solange wir mit der technikhistorischen Wissensproduktion ringen, zirkuliert dieser Austausch jenseits

der binären Grenze von Nord-Süd und wir müssen mindestens die Fließrichtungen Süd-Nord, Süd-Nord-Süd, Süd-Süd aber noch viele weitere Bewegungen und Gegenbewegungen in unsere Studien mit einbeziehe.

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I sincerely appreciate my friend, Margaret Njuguna, for proof-reading this thesis under such a short notice. To my fellow comrade, Jack Ong'iro Odeo; I just mentioned you by your three names as a sign of the high esteem with which I hold you. "Hembwo muno muno" for having your door open for me, whenever I called into Nairobi during my numerous field research trips. I am equally indebted to my colleagues and students at Maseno University, Kenya, whose unwavering support has been immense. To my family, relatives housemates and friends, "*asante sana kwa mchango wenu kuntu katika kuifanikisha ndoto hii"*. You continue to provide the wind beneath my wings as I soar on. Lastly, it is to the unsung heroes in the form of friends in Germany and beyond who in one way or another have made my PhD journey enjoyable, enriching and successful. "*Alluta continua".*

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PROLEGOMENON

> *The concept of history plays a fundamental role in the human thought. It invokes notions of the human agency, change, the role of material circumstances in human affairs, and the putative meaning of historical events. It raises the possibility of 'learning from history.' And it suggests the possibility of better understanding ourselves in the present, by understanding the forces, choices, and circumstances that brought us to our current situation. (Stanford Encyclopedia of History, 2007)*

While the history of technology as a discipline has developed tremendously in the North, it is a relatively new field of interest for the Global South, particularly Africa. A huge gap exists in African historiography in terms of technology studies. By studying the evolution of water and sanitation for Nairobi from 1899 to 2015, I contribute towards bridging this gap. In studying Global South cities, the debate has touched on the need to device unique approaches and new theorization away from the conventional practice that is perpetuated by the North.[1] Even though most research has tended to bracket the experiences of ordinary people and characterized cities in the South as chaotic, it is my submission that more representative research undertakings do not necessarily imply that these cities must be approached differently or in a special way. This is in agreement with Garth Myers' proposition that it is the historicity and particularities of these cities[2] that should concern contemporary studies rather than the attempt to view the Global South as exceptional. By seeking to complement rather than disengage from works that have laid the foundation for technology studies and infrastructure development in Africa and Nairobi, such as David Nilsson[3] and Ezekiel N. Nyanchaga,[4] I take a methodological shift to additionally employ oral traditions in rendering the African voice to the history of technology (HOT). This will bring on board the everyday experiences of ordinary people as users. I purpose to extend the existing debate by offering a socio-cultural and constructivist interpretation, adopting an integrated approach and exploring what this means for the history of technology.

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[1] See Robinson(2006, 2011; 2013)

[2] Myers (2011),pp. 101-106.

[3] Nilsson (2011; 2016; 2017)

[4]Nyanchaga (2016).

However, by acknowledging that this thesis arises out of an effort to address a lacuna in African historiography, with reference to the history of technology, I revisit the existing theoretical and evolutionary development of technology studies. While this may reproduce redundancy for a Global North reader, it is important because it acquaints readers in Africa with necessary background information. This places them on a trajectory of not only developing the history of technology as a discipline on the continent but also joining in the writing of global histories of technology. In the same respect, so as to provide a prism through which this work should be understood, this preliminary section unfurls the historiographical question, which according to this study, exists at two levels. First, is the near absence of the history of technology as a discipline in Africa, and the attempt is to locate it within the existing debates on society and technology. Secondly, I attempt to identify the gap in the existing literature by focusing on materials that dwell on the theorization of urbanism and the bracketing of Global South societies. By asking the following philosophical and theoretical questions, I level the ground and establish a backdrop for knowledge generation through a bottoms-up approach.

A) History

(i) What is the role of history and the historian's knowledge interest?

It is not the historian's sole aim to pose what, when and how questions by approaching history as an event bound in time that has already lapsed. Instead, history proposes to account for the past in a way that reveals the continuities and discontinuities in human actions and practices in relation to time and, in so doing, provide an understanding of the present that can speculatively point to the future. As Bill Nasson, Professor of History at the University Of Cape Town, South Africa, observes, in a language such as German, the terminology of *Geschichte*, which stands for history, carries the verbal connotation of a process that means an amalgam of the past, present and future.[5] A historian undertakes a journey of connecting the past to the present and the future in a manner that makes the study worthy and relevant. The historian's focus dwells more on (re)action, adaptationand transformation as the core engine of the historical process.

[5]See Nasson (2004), p. 3; see also Mahro(1984);Pomper, Elphick, and Vann,. (eds.) (1998); Stanford,(1994); Tosh (1984).

In bringing the potential of human action to the centre of the investigation, the dynamics of historical understanding can contribute actively to the shaping of our future, always emphasizing that it can be one of many possibilities and alternatives.[6] Sanford states that history need not be confined to kings and battles and great men. Perhaps we can treat it practically, using it for our purposes.[7] Writing history from below would make it a worthy engagement that is representative of the society as a diverse entity. The day-to-day experiences of society, without necessarily focusing on the monumental moments, events, or individuals, can develop knowledge that is seen to encompass the realities of a society in its past, present and perhaps the future. The writing of this kind of history, therefore, has to start by asking the right questions, re-questioning the existing knowledge and putting human experiences at the centre. The narrative of progression as an evolutionary outcome has to be juxtaposed against the continuities and discontinuities that inform the nature and character of a society.

(ii) What is the meaning of history and technology?

While Europe dominated and patronized the age of science, it sought to subordinate other societies by blatantly choosing to define history and technology in a way that hegemonized the rest of the society. Despite progress being made towards having more inclusive explanations of what constitutes history as a discipline and knowledge in general, Africa still plays 'catch up' compared to many other societies. There exist large gaps in the historiography of Africa with respect to technology studies.

One of these gaps is that the history of technology as a discipline in Africa is either non-existent or, where it has sprouted, it has stagnated in its infancy. The second gap, one perhaps of major concern, is that the literature emerging from studies conducted on Africa has always approached issues pertaining to the African continent from a vantage point of superiority of Western scholarship and Western society at large. Tragically, this kind of scholarship has produced works that are silent about the narratives of local-level technological triumphs, adaptation to incoming technologies, rejection or contestation of imported technologies, as well as thefailure tosee users as tinkerers. Africanist historian Clapperton Mavhunga indicts Westernized approaches for this

[6]Nasson (2004), p. 3.

[7] Sanford (1994), p. 112.

tragic state by observing thatwhile STS in traditional practice is good at identifying banal forms of science and technology; it is severely limited in Global South societies in which the black and white of things that are technological and scientific are not or may not be readily recognizable.[8]

The bracketing of African-lived experiences in the literature emerging from the research carried out on the continent occurs either by design or default. History as a discipline in Africa is a phenomenon of the latter half of the 20th century. The slow pace in the growth of the history of technology as a domain is established first as emanating from a methodological dilemma and, secondly, as a result of the obsession by nationalist historiographers to concentrate on socio-political histories and the neo-colonialist debates that have focused more on the colonial (dis)continuities persistent in the post-colonial world. In terms of methods, the belief is that the attempt to study local societies within certain predetermined frameworks that are popularized under Western scholarship has, many times, produced non-comprehensive results that have led to either misconstrued or subjective conclusions reminiscent of the colonial period. The unilateral approach to knowledge in technology studies that see users, especially in the Global South, as either passive recipients or as incapable of invention, continues to propagate notions of superiority of 'things' from outside. This leads to the production of what Adiele Afigbo, in his attack on colonial historiography on Africa, conclusively referred to as 'bastard historiography'.[9]

As is widely documented, the period leading to the early 20th century witnessed the promotion of Eurocentric interpretations of history and the well schemed grand plan of dismissing non-European cultures. Cultural nodes like Africa were characterized by Hegelian thought as devoid of history. The notion of the 'dark continent' was propagated, and Africa today still grapples with the after-effects of such defeatist psychological imperialist analogies. Topographies and topologies of knowledge outside Europe and North America were described as backward and primitive to the extreme.

[8]Mavhunga(2017), p. xi.

[9]Afigbo(1993), p. 46.

It is within such lines of thinking and practice that the history of Africa was written as 'the history of Europeans in Africa'. This implied that history began in Africa only when the European explorers, traders, interlopers, adventurers and philanderers penetrated the region south of the Sahara. European imperialism and colonialism in Africa was not basically territorial occupation and political subjugation. It went further by instituting a system of socio-cultural domination. Extrapolating from such an understanding, what did such marauding Europeanism imply for indigenous technologies and the colonized peoples' everyday interactions with their surroundings?

Entrenchment of colonialism reached far and wide and, as espoused by Headrick, technology became the tool of empire.[10] As the maxim gun served its purpose of plunder and conquest during pacification, the handgun was used for control and suppression. Many other technologies went along way in ensuring social subjugation and differentiation. Colonialism in Africa produced devastating results. It did not matter whether it was under British policies of direct and indirect rule, French assimilation or association, Portuguese high handedness or the Belgians' malignant indifference in the Congo.[11] Perhaps one of the greatest effects of the European 'colonial enterprise' in Africa was the huge discrepancy in the socio-economic make-up of societies. Colonial scholarship of Africa as part and parcel of the grand imperialist scheme, on the other hand, resultedin huge knowledge gaps characterized by biased, fragmented and incomplete accounts about Africa and other 'non-industrialized' societies.[12]

The aftermath of the 2nd World War provided an opportunity to re-examine how societies related to each other in pursuit of international peace. If the signing of the Atlantic Charter was a denunciation of oppression, subjugationand servitude in the world, then the path to the admission of equality of all persons demanded the demolition of the oppressive structures and pseudo-ideologies of the superiority of certain races. Scholarship and history, in particular, needed to shed the misrepresentation of some societies and the silence on their day-to-day lives in most

[10] See Headrick (1981).

[11] Khapoya (2016); see also Henriksen (1973), p. 406; Mazrui (1969), pp. 661-666; Crowder (1968), p. 2; Settles, (1996), see also Boahen, (1985, 1987), Henderson and Whatley (2013), pp. 1-25.

[12] see Arowosegbe (2014), pp. 308-321.

literature. The process of rewriting history had to commence as the decolonization process stretched beyond political independence and assertions of nationhood.

It thus followed that pan-Africanists started laying the foundation for revisionist efforts in the development of African historiography. Institutions like the School of Oriental and African Studies (SOAS) in London and the two American universities of Wisconsin and North Western University took it upon themselves not only to train the pioneer Africanist historians but also to introduce material on Africa in their programmes.[13] As Patrick Manning observes, the fields of European and American history underwent booms in the post-war years, fuelled by economic and educative growth. They focused heavily on the development of national political communities and on their modernization. At the fringes of Euro-American national history lay the frameworks of imperial and colonial history, western civilization and expanding area studies programmes. From these fringes emerged the academic fields of African and world history.[14]

The question of how best to initiate the 'African recovery and agency' had to be coupled with a methodological shift. Through inter-disciplinary approaches that encompassed anthropology, linguisticsand archaeology, amongst others, the 'African initiative' got underway. The decolonization process had to spread beyond political independence and institute a process of re-asserting a sense of pride in that which was indigenous for societies in Africa. In doing this, oral traditions gained centrality in the 'recovery' of African history. This marked a watershed moment in the development of African historiography as new literature arrived covering the history of various peoples on the continent. While the political and economic implications that resulted from decades of European colonialism in Africa have been highlighted through various nationalist histories, a huge lacuna exists in terms of socio-cultural histories. This is more pronounced specifically for environmental history and history of technology.

Concomittantly, history of technology emerges as a relatively new field in Africa. Europe and European scholarship have dedicated a lot of resources towards the

[13] Watterson (2008).

[14] Manning (2013), pp.319-330.

development of knowledge on the growth, organization and arrangement of cities and the centrality of technology in driving change in their societies at all levels. The current situation reveals the existence of a body of literature emerging from Asia and Latin America that specifically focuses on technology studies and the history of technology. India enjoys the lion's share on this front, perhaps for reasons that can be historically located in its long civilizational history and its pivotal role on the imperial expansionist frontier as a coveted British colony. Furthermore, with India having served as a template on colonial administration, especially in the larger British Empire, it perhaps presents the most ideal laboratory to explore the nexus between society and technology.

Notwithstanding that, what has been termed as 'the Global South' in contemporary scholarship continues regrettably to be bracketed in most literature. The linearity in the approach to the subject of travelling ideas, ideals and technologies has minimized the scope of knowledge, especially on how the process of invention, innovation and appropriation unfurls. The Global North is not only over-represented but is also propagating the status quo. The inertia in the history of technology in the Global Southhas become a major impediment to filling the historiographical and knowledge gap that exists in this sphere.

In terms of how technologies are contextually interpreted, scholars like Arnold have justifiably questioned the tendency of many historians to treat colonialism as an undifferentiated whole, and their disposition to see technology as an instrument of empire.[15] The end result has been a failure to acknowledge the flows and counter-flows of ideas that emerge from a much broader perspective of technology as a cultural space in which various forms of interaction take place. The colonial and postcolonial binary that has dominated scholarship has presumably precluded a fuller understanding of the multifaceted ways in which the Global South has engaged with the larger world.[16] It is at the interface between the technology and the user that in the focus needs to be. To make his point, Arnold continues by proposing that the history of technology has

[15] Arnold (200), p. 87.

[16] See Simone (2001), p. 19.

to,thus, move beyond a focus on investigating origins and inventions (which has led to Europe being privileged) to an inquiry that centres on uses, meaningand effects.[17]

Edgerton, in what he refers to as 'creole technologies', prompts us to engage with history and not just the question of technology, and that this ought to be done in a particular way that offers a new way of post-contextualist history to those already available. The historian's focus should be on writing a 'history of content and context together'.[18] This is with respect to what indigenes, rather than colonizers,make of new technologies that are, as yet, little understood. Perhaps, it is by borrowing from such histories that the lenses need to be refocused sharply on the experiences of indigenes in their day-to-day interactions with technologies as inventors, users and tinkerers. Acknowledging the local processes and platforms of innovation is a step in the right direction towards a comprehensive history of technology that explores the socio-economic and political facets of technologies.

B) Urban Studies

(i) Reflections on Urbanization and Urbanism in Africa

Undertaking a study on infrastructure systems and focusing on the technological components of urban service provisioning requires us to historically contextualize ourselves as a way of establishing the framework within which such work is to be understood. The attempt to reflect on the question of urbanization in Africa, thus, is a simple exercise of exposing the lack of consensus amongst scholars on what merits urbanization, and the fluid way in which the question of urbanization has been handled throughout time. It establishes itself as an exercise not only to recover the local agency in urban provisioning for water and sanitation for a city like Nairobi, but also as a way of addressing the huge historiographical gap that exists in the history of technology in Africa and the cultural biases eminent in the theorization of the process of urbanization. The question of what definitively explains the process of urbanization, specifically for Global South societies, lingers on and the scholarship around it has been criticized for being supremacist and non-inclusive. The following is an attempt at delineating the

[17]Arnold .op.cit., pp.81-106.

[18] Edgerton (2007), p. 9.

issues along this narrow path of locating the 'local' in urban studies as we set a platform on which the current study has to be interpreted and understood.

(ii) The Binaries of North versus South: Seeking an inclusionary explanation of the process of urbanization

Urbanization is as old as history. As a process of transformation in society, it is seen to epitomize civility, progressand development. From the Neolithicperiod to the digitalized world of today, human evolution has been marked by a structure of growth that has seen different forms of agglomeration that have, alongside other revolutionary developments, resulted in what is characterized as urbanism. While current scholarship and global policy agencies seem to be at a consensus in defining urbanism by its demographic purview,[19] what should capture our imagination is the question of whether it is enough to see urbanity in terms of the number of people conglomerating within a certain prescribed geographic location or to approach it as a multi-pronged space exhibiting both demographic and geospatial trends. As an ever-evolving phenomenon, what are the other unique facets that distinguish an urban area from any other form of settlement? Do the means of procuring the socio-economic needs of the populace that occupy such areas play a part in reinforcing urbanity as a phenomenon and status? The day-to-day practices of a people go a long way to define their form of existence. Once established, do urban areas assume a life of their own and in themselves become forces for change and transformation?

As Kingsley Davis argues, urbanization represents a revolutionary change in the whole pattern of social life. Urbanization, itself a product of basic economic and technological developments, tends, in turn, once it comes into being, to affect every aspect of existence.[20] Once established, the city becomes a centre for political power and influence throughout the whole society, no matter how agricultural or rural it may

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[19] McGranahan and Satterthwaite(2014), p.1-28; *see also* UN-Habitat World Cities Report.2016. http://nua.unhabitat.org/uploads/WCRFullReport2016_EN.pdf (accessed 17 October2017); *see also* World Bank (2013b) ' Harnessing Urbanization to end Poverty and Boost Prosperity in Africa: An Action Agenda for Transformation; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/10/21/000442464_20131021121716/ Rendered/PDF/815460WP0Afric00Box379851B00PU BLIC0.pdf, (accessed 28 March 2016); *see also* You, N. 2007, pp. 214-220.

[20] Davis (1955), p. 2.

be.[21] The city as a space emerges out of and encompasses demographic shifts, itself remaining prone to all kind of interminable change in its materialities.

It follows that cities, with their extreme agglomeration of people and unprecedented densities of technology, have been at the core of modern history and modern society. [22] However, despite the consensus on what demographically distinguishes urbanity and the contemporary trends towards the homogenization of urban spaces across the globe, various cities have been informed by unique histories that set them apart as they navigate through various epochs, carrying along certain aspects that transcend space and time. On the global map, each city thrives differently, despite a demonstration of either conformity to the general trends of migratory ideas and ideals or a clash of the new and the old, the indigene and the exotic, the persistent and the flexible, the rigid and the fragile representing their social-political fabrics. It is through these lenses that I presume that current scholarship should be founded, away from the prisms of progressive versus 'static' societies.

In retrospect, while it is not disputable that the emerging cities within the 'civilizing world' are key indicators of progress in the general way of human life, scholars like V. Gordon Childe, by emphasizing writing as paramount to the process of urbanization,[23] emerge as enthusiastic apologists of the European imperial hegemony. The main purpose of their line of argumentation, either out of ignorance or as a deliberate act, was to deny those they characterized as 'pre-historic societies' their rightful place in history and justify the domination of Global South communities through colonialism. Their mantra was that 'history begins when man takes to writing'[24] and with that, they justified the suppression of oriental and African societies. Writing provided a soft pair of gloves with which the Eurocentric scholars adamantly feigned blindness to 'progress'of non-European societies. In hindsight, writing ought to be seen as pivotal

[21] Ibid.

[22] Hard and Misa(2008), p. 82.

[23] Childe (1950), pp. 3-17; see also Mabogunje (1969), pp. 121-203.

[24]In 1923, the European scholar, A.P. Newton, addressed the Royal African Society on the topic, 'Africa and Historical Research'. He declared:'Africa had no history before the coming of the Europeans. History only begins when men take to writing. And since Africa had no knowledge of writing, information of African history could be found only in material remains, in language and in primitive culture. These are the concerns of linguists, archaeologists and anthropologists and not the concern of historians'.

to the development of 'useful' sciences that bore sophistication to what characterized urban spaces in the North and not as 'a precursory imprint of urbanity'.

In a demographic sense, many theorists have tended to focus on the rural-urban population shift as the foundation of urbanization but, at the same time, identify industrialization as the basic driver behind the movement of rural population to urban areas for factory jobs.[25] The problem with this focus on the rural-urban population shift binary is that it fails to broadly delineate all the forces, whether centrifugal or centripetal, that drive urbanization. Is the emergence of cities equivalent to what we characterize as urbanization? Perhaps, to broaden the scope of understanding of the concept of urbanization, Xizhe Peng, Xiangming Chen, and Yuan Cheng state that the human ecology paradigm developed. If put in perspective, according to Robert Park and others, human ecology developed to describe the structure and evolution of the American city, primarily Chicago in the 1920s to 1930s.[26] It was based on assumptions of the interactive role of population dynamics, market competition, material technology (for example transport infrastructure) and the built environment in the making and remaking of urban life.[27] Advances in technology, the emergence and growth of industries that provide wage labour and produce a surplus to spur marketization, cultural diffusion and, most of all, information flows became key drivers of urbanization as understood from a human ecological and later a modernist point of view. The cities' dynamism is informed by the pull and push factors operating at hand.

However, the main weakness of these endogenous and human ecology theoretical perspectives, amongst many other post 20th century paradigms, is the fact that what they espouse provides only explanations on European and North American urbanism. Urbanization in the rest of the world is seen as resulting from the spread of European imperialist hegemony and American liberal capitalism. As posited by Fox, through trade, colonialism and (in the latter half of the 20th century) international development assistance, the key technological and institutional developments that set Europe's urban transition in motion were diffused to other regions, stimulating urbanization in these

[25]Peng, Chen and Cheng, *undated*.pp. 1-16. (Accessed at *https://www.eolss.net/sample-chapters/C04/E6-147-18.pdf*on 2 November 2016).

[26]Ibid.

[27] Hawley (1981), Orum and Chen (2003).

regions as well. The onset of the urban transition in any given country or region should, therefore, be understood as part of a global historical process linked to technological and institutional change and diffusion, not simply as a product of endogenous economic and demographic forces.[28]

Deriving from such schools of thought, pre-colonial settlements in the former colonies are seen as lacking a demographic and technological threshold. But historical evidence proves that some of the oldest civilizations in Asia and Africa produced magnificent dwellings of an urban kind, as supported by the existence of thriving indigenous knowledge extracts, food productionand strong polities. Although this is not the case for all cities, for example, Nairobi–which grew organically, starting in 1899, from a European colonial railway outpost–archaeological evidence and oral histories, as major methodological approaches towards reconstructing the history of prehistoric societies, confirm the presence of urban settlements in sub-Saharan Africa for over 2000 years.[29] However, these settlements remained relatively small, fewand far between in comparison to other regions of the world; most proved ephemeral.[30] It is this fact that sees them removed from the debate on what urbanization implies for modernist scholarship.

If European civilization is presumptively the model for understanding urbanization, then it follows that no form of pre-colonial agglomeration in Africa would fall within the precincts of what is broadly acknowledged as the form and nature of a city. The majority of scholars are sceptical in their view of the pre-colony in Africa and posit that though small settlements emerged in Africa, none rose to be a manufacturing centre.[31] The push bydrastic innovations in terms of technologies for mass production and the rapid wave of industrialization that happen to have been at the core of European urbanism are unequivocally reported to be absent and, hence, render pre-colonial Africa non-urban. Snippets of urbanism appear when itis argued by Horace Miner in his edited

[28] Fox (2011), p.9.

[29]Anderson and Rathbone (2000).

[30]Ibid.

[31] Becker, Hamer and Morrison (1994).

work, *The City in Modern Africa,* that urbanization during the pre-colonial era was as a result of politics.[32]

According to Miner's analysis, economic development, which modernization theorists see as a precursor to political development, did not occur before political development. It was, rather,economic development that necessitated political organization; thus, there is the presence of defence. Urban areas developed not only because of the establishment of administrative centres, but because trading, port activities, religious activities, and defence needs also caused towns and cities to grow. Rural surpluses, as well as the growth of exchange economy, resulted from the provision of defence and creation of trans-shipment posts. This led to the establishment and growth of urban centres.[33]

Analysing the existing knowledge, we can state that the greatest challenge to research as a whole, and history in particular, is its perpetual treatment of Africa as a whole and Africanism as an over-riding cultural orientation. Most scholarship has endlessly conceptualized sub-Saharan Africa as a single mass of existence. The failure to acknowledge the diversity that exists on the continent socio-culturally and ecologically is in itself self-defeating. The misinformation perpetrated towards understanding urbanity alongside other aspects results from the generalized approach to studies on the sub-Saharan region. While the idea is not to treat every part of the continent as unique and different, it is important for every case to be located contextually and analysed with certain specifics that derive from every community charting its own independent path based on the prevailing factors. Insofar as it can be established, West Africa, North Africa and some parts of central Africa exhibit evidence of the earliest forms of urbanization.

Despite the diversities in terms of appropriation of urban spaces across the African continent, it is the advent of European colonialism that emerged as a watershed in the history of cities in Africa. Colonialism through its imperial tentacles stamped itself on the African continent by mostly altering the character and form of cities. As observed

[32] Miner (1967).

[33] see Tettey (2005), p. 25.

by Freund (2007), this advent and consolidation of European colonialism was marked by aspects of resistance to the re-development of old cities. For instance, the Germans ruthlessly hanged Rudolf Manga Bell in Douala, Cameroun, for leading protests.[34] Depending on the manner of conquest and systems of administration adopted, some cities were run down completely, some new ones emergedand others survived the onslaught, retaining their original selves. Conquest was marked by continuities as well as discontinuities, hence producing the duality that characterises most contemporary urban spaces in Africa.[35]

Such representations of 'duality' are not a recent phenomenon in urban scholarship. Cities have traditionally been understood as socially dualized through the lenses of native versus immigrant settlers, age differentials, ethnicity and education, amongst other factors, as polarized extremes.[36] Fanon draws the binary of a settler town built of stone and steel, and the native or negro village, the 'medina', as a town on its knees and wallowing in mire.[37] Abu-Lughod stated that the major metropolis in almost every newly industrializing country was not a single unified city but two different cities physically juxtaposed but architecturally and socially distinct.[38] Freund indicates that the dual city in Africa is a widespread phenomenon, necessitated by various historical and political factors in the face of European hegemonization.[39] Although Peter Marcuse challenges the dual city thesis by arguing that a complex reality exists in the contemporary city in terms of multiplicity ('several different groups and quarters') rather than duality, this thesis brings forth a different kind of duality in terms of the technologies of social service provisioning and the inertia of centralized networks vis-à-vis the active movements from 'off-grid' localities, otherwise known as peri-urban and informal urban spaces. Rather than interpreting the urban as a case of two polarized extremes, as is the case in Mollenkopf and Castell's thesis, the large technical and centralized systems, or rather the 'networked city', must be seen asexisting in complementarity with the devolved topologies that operate adjacent to planned zones.

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[34] Freund (2007).

[35] Ibid.

[36] See Mollenkopf and Castells (1993), pp. 254-5.

[37] Fanon (1961), pp. 37-39.

[38] Abu-Lughod, (1965), p. 420.

[39] see Freund (2007).

However, to some extent, viewing 'colonial cities' as 'dual cities' is misleading since colonial societies cannot be understood merely in terms of a 'European versus Indigenous' dichotomy. To take such an outlook omits the agency of indigenous societies, their capacity to overcome such divisions, to ignore them or even to imagine them differently.[40]

Eric Wolf, in *Europe and the People without History*, argues that a creative stretch between macro and micro-histories is required to enable those people who claim to own history and the ones to whom history has been denied emerge as participants in the same historical trajectories.[41] Urbanization that is assumed to represent a form of civilization and a categorization of society into progressive and non-progressive groups entails thedenying of 'others' their history. It is these forms of bracketing available in the multiple histories emerging across the globe that call for a more extensive engagement that would correct the weaknesses in approaches to production of historical knowledge, especially for the South.

C) Structure

This prolegomenon has set out to establish a frame within which the work is to be understood. It has asked philosophical questions on what constitutes history and the historian's role in knowledge production, and it has discussed the relationship between technology and urbanization.

Chapter One introduces the statement of the problem, the research questions and the objectives of the study, hypotheses, and methodology, as applied in collecting the relevant data. The chapter situates the study in Nairobi by exploring the current status of water and sanitation and the precarious nature of its existence in terms of infrastructural development.

Chapter Two offers a broad analysis of the existing literature. Specifically locating and delineating the infrastructure and technology debates within the realm of STSs and the

[40] Fourchard(2011), pp. 223-248.

[41] https://is.muni.cz/el/1490/podzim2013/CZS13/um/lecture1/1_4_Wolf.pdf

history of technology. It further offers a sneak preview into the main questions under discussion in the entire thesis as a way of laying a foundation for understanding the key points of departure.

Chapter Three narrows down the case for Nairobi, exploring the rise of the city and the evolution of its water and sanitation infrastructure system within the period leading to the immediate aftermath of World War I (1899 to 1919). The debate, as discussed, unearths the genesis of Nairobi's water and sanitation problems as located both in planning policy or its absence, and the competing administrative centres of power, that is, the railway corporation and the colonial office through the Commissioner. The chapter also sets the basis for the discussion of the segregationist approach to the deployment of key infrastructural projects, including water and sanitation. The discussion juxtaposes the emerging centralized systems of supply against the indigenous and bottom-up means of access.

Chapter Four, which incorporates the 1920 to 1963 period,focuses on the change of status of Kenya from a protectorate to a colony, and what this change implied for the water and sanitation topologies of the nascent city of Nairobi. The overriding theme is the politics of infrastructure and whether segregation is pursued as a deliberate policy or results unintentionally from the economics of provision and access. The key goal is to push the discussion beyond the normative and simplistic debates that conceive spatial inequalities within a racial binary. It is not a case of either one or the other but rather a broader framework of analysis that sees indigenes as capable of agency in employing innovative and creative technologies in meeting their day-to-day needs. In providing these dissections, the distinction, the representationand the performance of infrastructure systems vis-à-vis their various imageries are explored. The post-World War II period upto 1963 highlights the question of financing for infrastructure as dominated by big international monetary agencies and how the development or a high-modernist debate shaped the nature of infrastructure provision, in this case, water and sanitation for Nairobi.

Chapter Five (1963 to 1978) sets out to unearth and answer the questions relating to continuities and discontinuities and their implications, especially for the growing group

of urban underclass within the burgeoning informal and peripheral settlements. Local initiatives as espoused through self-help ideals come to light to reveal the potential that is within bottom-linked approaches to social service access, yet autocratic and municipal centralization impede the ability of the ordinary people to innovate and invent their livelihoods.

Chapter Six explores the paradoxical maxim of the period commencing in the 1980s, especially with reference to the practice and policy approaches for cities in the Global South. It brings to the fore 'appropriate technology' ideals by locating the user and the shifts, if they exist, in the conception and provision of water and sanitation. Off-grid, or what I refer to as the bottom-up approaches, are explored against a backdrop of governance, political pluralism and flexibility.

Chapter Seven offers an aerial outlook of the entire text, with the aim of situating it in the contemporary debate, especially around the discourse on the social and political nature of technical artefacts. It reinforces the contextualist approach towards the writing of the global history of technology. This chapter offers a sneak preview into the need to expand the theoretical and methodological frameworks that look beyond the North-South asymmetrical binary of knowledge flow.

CHAPTER ONE

LOCATING THE PROBLEM AND DELINEATING INFRASTRUCTURE DEBATES

1.1 Nairobi's Geologyand Hydrography

Volcanic activity has dominated the geological history of the Nairobi area since Miocene times and has controlled the geomorphological evolution.[42] Apart from a few isolated occurences of Precambrian and Quaternary rocks, the area is composed of volcanic rocks that originated in the Rift region and flowed eastwards on to a warped and partly dissected pre-Miocene erosion surface, cut a cross the older crystalline rocks.[43] Four prominent physiographic units are recognised in the Nairobi area reflecting the volcanic rock types and the tectonic movements that have affected them. They are the; lava plains, the Kikuyu highlands, Rift flank and the Ngong Hills. The main drainage is consequent upon the regional slope of the volcanic rocks towards the east, while subsidiary internal drainage into the Rift region is confined to the western part.[44]

The lava plains east of the Ruiru-Nairobi-Ngong area are underlain by a succession of lava flows alternating with lakebeds, streams, deposits, tuffs and volcanic ash. These plains, comprising mainly of the Athi Plains and the northern section of the Kapiti Plain, extend westwards rising from 4900 feet (1493 m) at the Athi River to 6000 feet (1829 m) in the faulted region near Ngong.[45] The water draining eastwards from the hill area accumulates on the low lying ground between Parklands in the north and Nairobi South estate, forming a perched water table above the Nairobi phonolite. The Kerichwa Valley Tuffs lying to the east function like a sponge and the contact between them and the underlying impermeable phonolite thus forms a perfect aquifer, so much so that a number of channels containing water occur beneath Nairobi.[46] The soils are

[42]Saggerson (1991), p. 5

[43]ibid

[44]ibid; see also Morgan (1967) for a comprehensive review of the area.

[45]Alukwe (2016). See also Saggerson (1991).

[46]Alukwe (2016), p. 16

products of weathering of many volcanic rocks. Weathering has produced red soils that reach more than 50 feet (15 m) in thickness.[47]

Nairobi River is a river flowing through the Kenyan capital Nairobi. It is the main river of the Nairobi river basin, a complex of several parallel streams flowing eastwards. The river is joined by several tributaries that include; Ruiru River, Kamiti River, Kasarani River (aka Gathara-ini), Ruaraka (aka Rui Ruaka), Karura River, Gitathuru River (aka Getathuru), Mathare River, Nairobi River (the main channel), Kirichwa and Motoine-Ngong River which flows to the Nairobi Dam, an artificial lake meant to provide drinkable water for residents of Nairobi (but currently polluted and not usable).[48]

A feature of the streams and rivers in Nairobi is that they all flow eastwards. The Western half of Nairobi marks the start of the ascent up the Rift Valley escarpment while the Eastern half is a flat plain. The rivers therefore flow by gravity to the East. All these rivers and streams join the main river of the Basin – the Nairobi River – near Dandora and Ruai which then proceeds to join the Athi River. Another feature of the rivers in Nairobi is that most informal settlements are located along river valleys.

Nairobi draws its water from three main catchment areas. This comprise the Aberdare ranges, Mt. Kenya and the Rift Valley. However, the Ndakaini Dam, which lies about 50 kilometeres (30 miles) north of the capital, is Nairobi's main source of water. The Nairobi utility receives 94% of its water from the Tana River basin north of the city through three reservoirs: the Sasumua Dam on the Chania River, the Thika Damand the Chania-B Dam. The Thika Dam (Ndakaini) is the largest, supplying 225,000 m3/day. Water from the reservoirs is treated in two treatment plants, including the largest one in Ngethu. The remaining 6% comes from local sources: the Kikuyu Springs and the Ruiru Dam, both located in the Athi River Basin and whose water is treated in two smaller treatment plants on site.[49] Ondiri wetland lies about 20 kilometres northwest of

[47]Saggerson (1991)

[48] retrieved from; *https://www.revolvy.com/page/Nairobi-River*

[49]Nairobi City Water and Sewerage Company:*Map of Nairobi water sources*

Nairobi and is Kenya's deepest freshwater swamp—could help supply more drinking water to the city's growing population if well protected and harnessed.[50]

Groundwater supplies an additional 85.000 m^3 per day or more from an estimated 3000 boreholes, up from an estimated 2250 boreholes in 2001. The groundwater table has declined; in one well it declined by 40 meters between 1958 and 1996. The average depth of new wells in 2001 was 238 meters. In that year 97 new wells were drilled because of a drought. Most wells are operated by industrial enterprises, hotels, farms for flower production in greenhouses, and private houses in parts of the city that receive only intermittent supply (e.g. Langata and Karen). Groundwater is also used to irrigate gardens and to supply tankers that resell the water. Many private well owners are also connected to the mains water supply network and use groundwater as a back-up supply. Natural groundwater quality is good. There are few data on whether the aquifer has been polluted or not.[51] At the height of another drought in 2008/2009, Athi Water Services Board drilled over 40 emergency boreholes in various parts of the city and connected them to the distribution network.[52]

1.2 Nairobi's Water and Sanitation Status

Today, Africa continues to urbanize rapidly, both as a result of the diminishing rural livelihoods and urban bias policies that prompt massive rates of rural-urban migration and through internal population growth due to improved reproductive health. Nairobi and Dar es Salaam have been reported as the fastest growing cities in Africa, with a projection of a 77% and 85% growth rate between 2010 and 2025 respectively.[53] The challenges that come with these high rates of growth call for extensive approaches on the functionality of such cities and their sustenance. The partly dysfunctional nature of those cities, as castigated by most global North scholarship, thus, calls for new approaches that would comprehensively represent the realities of the cities in the South. This study on Nairobi's water and sanitation infrastructure serves as an important step

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[50] *https://www.reuters.com/article/us-kenya-water-climatechange/nairobi-looks-for-new-water-to-ease-its-growing-thirst-id USKBN1J8269*

[51] Foster &Tuinhof (2005).

[52] https://jambonairobi.co.ke/services/water-in-nairobi/water-supply-to-nairobi/4/

[53] The African Development Bank reports in *Tracking Africa's Progress in Figures,* as accessed from http://www.africastrictlybusiness.com/lists/top-20-fastest-growing-african-cities on 04/16/2016

towards achieving this goal. While the major concern is not centredon Nairobi's urbanism *per se*, the question of technologies of water access and the modalities of ridding the city of its wastewater guides the study in its dimensions of capturing the people's day-to-day experiences as Nairobi evolves through various epochs.

1.3 Problematique: The State of Water and Sanitation Infrastructure Supplyand Access for Nairobi

Nairobi's water has over time been harnessed from a combination of both surface resources and ground sources, basically wells and boreholes. The water infrastructure network extends from catchment towers close to 40 miles away through river extraction. These flow into the two-tier system of supply, namely, Kabete and Gigiri. The majority of the city's residents rate improvement in water provision as their top development priority.[54] Most of the urban poor lack a private water connection. Even in those estates where there is a household connection, competitive pumping by neighbours exacerbates frequent prolonged scarcities that leave them without water.[55] The supply network is not only skewed but is also unreliable for most residents. For the underserviced and unconnected, what have been the mechanisms of access and supply? What are the indigenous technologies supplementing or filling in for the failures of the centralized network system?

According to the International Water Association (IWA), sanitation provision in Nairobi is grossly deficient.[56] The UN Habitat in 2003 reported that about 10 percent of Nairobi's population was served by sewers while 20 percent relied on septic tanks and the remainder used latrines. The bulk of Nairobi's population still relies on traditional pit latrines. Nairobi has two major sewage treatment plants since the closure of the Eastleigh plant; Dandora, with a daily treatment capacity of 80,000m^3, and Kariobangi, with a daily capacity of 32,000m^3.

While Kariobangi is a conventional plant based on biological aerated filters, Dandora is a lagoon-based plant[57] with stabilization ponds. However, with only the planned areas

[54] Citizen's Report Card (2007); Gulyani, Talukdar and Kariuki, (2005).

[55] Citizen's Report Card (2007).

[56] Accessed from www.iwawaterwiki.org,

[57] See ECFA (2008).

of the city, which house only close to 40% of the population, connected to these sewer lines, the real sanitation challenge is within the informal areas,where the majority of Nairobians reside. Municipal and city authorities in their master plans treat these informal areas as blank spaces and blind spots. Excreta waste from such 'flexible' (informal) areas render river water in Nairobi unsafe for domestic use due to open dumping and defecation. As a result, the cityfinds itself in a dire situation in terms of its water and sanitation systems. The poor get by on their own means. With these realities that represent inefficiency and inadequacy, what are the upward movements from below in terms of adaptation, hybridity, improvisation, tinkering, rejection and protestation, both as innovative and appropriative ventures. To what extent can informal areas that operate off the grid through individualized approaches and community led micro-networks be characterized as innovation junctions?

The problematization of the water and sanitation situation in Nairobi for the purpose of this study does not dwell on the question of the deficiency of the infrastructure systems in terms of access. Instead, it focuses on the evolution of systems of supply and the technological questions in terms of implications, application, appropriation, contestation, adaptation and innovations from below, which aim to equalize the eminent shortages deriving from municipal practices of centralized supply systems.

Taking the analyses that exist, which have been conducted from an LTS (large technical systems) perspective, as a departure point, the study narrows down the role of users as participants in the making of the histories of the city and as non-passive recipients of migratory ideas and ideals, especially in the process of procuring their day-to-day critical needs. The process of appropriating technology is neither passive nor a seamless flow from top to bottom.

Technical infrastructural artefacts are looked at as multi-layered and possessing a powerful political and economic nature that determines who has access to them. Moving between the formal level of engineering and planning and the informal level of daily practice, the dissertation investigates how urban water and sanitation technologies were adopted, appropriated and contested by various actors. By questioning existing historical trajectories and the general scholarship on urbanity, technology and society in

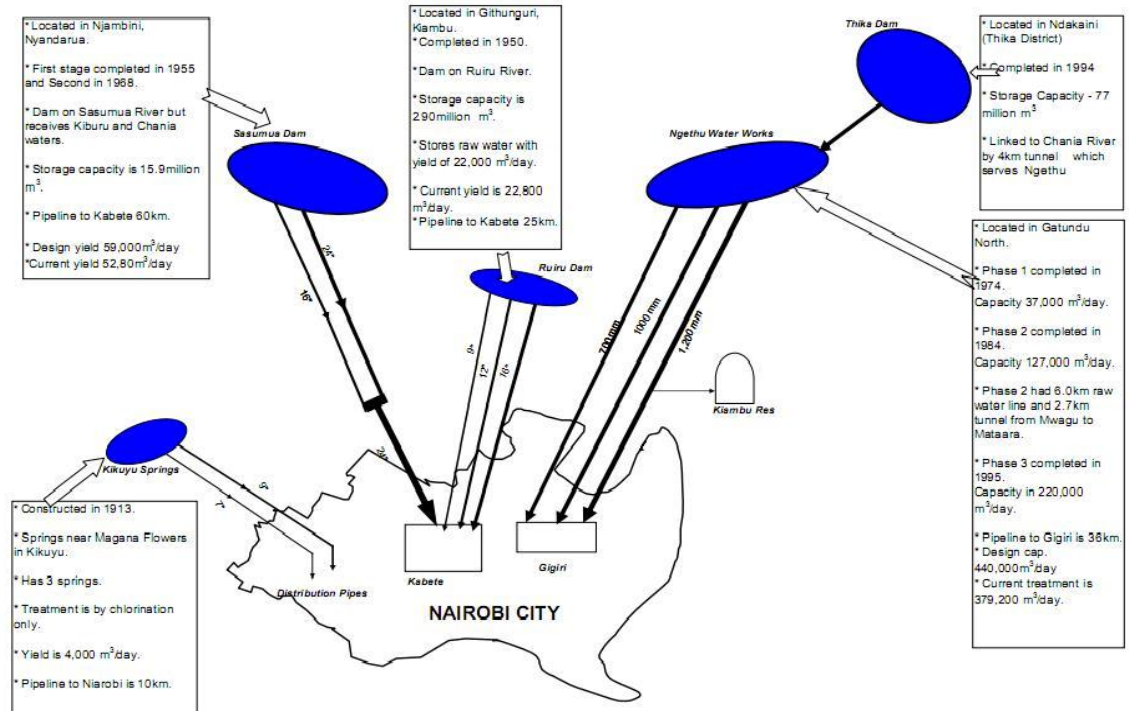
Africa, this study seeks to locate the ordinary peoples' agency in infrastructural developments as localized processes. I explore the deployment of Nairobi's water and sanitation infrastructure systems and construct narratives that emanate from below to embody the daily experiences and practices of off-grid dwellers and operators in a socio-spatially fragmented city like Nairobi. People or users must be seen as co-producers, or as has been aptly put, as 'producers'. All these questions are addressed within the post-colonial theoretical framework that is believed to possess greater potential for clarity in delineating aspects of continuity and discontinuities, plus the counter-reactions that characterize not only the evolution of cities like Nairobi but also inform post-independence debates in most of the Global South.

I also re-question how various scholars have approached technology studies. This I achieve by unpacking infrastructural artefacts as socially and culturally constructed, interpreted and envisaged. This undertaking not only proposes to fill the historiographical gap present in the history of Africa, specifically the history of technology, but it also aims at delinking this history from the perpetual top-down approaches that tend to bracket the experiences of indigenes. The history of urbanization in Africa has been written and approached as the history of European activities in Africa many times, and indigenes are treated as the docile recipients of European civilization who lack agency.

Of particular interest for this study is that the decolonization process in Africa, despite acknowledging the need to revise the colonial historiography, has failed to comprehensively address all facets and, instead, has concentrated on nationalist histories that sometimes over-glorify the pre-colony era. Consequently, environmental history and the history of technology constitute part of the neglected or forgotten histories of Africa. It is this lacuna that exists in African Studies and, particularly, histories of technology that I seek to address by pioneering this work in tandem with the foundation being laid by scholars like Nillson (2011; 2016; 2017) and Nyanchaga (2016). Nyanchaga (2016), in particular, offers a detailed account of the development of Kenya's water landscape and specifically addresses policy questions in terms of various legislative and reform exercises. As a civil engineer by orientation and having worked closely with international development partners as a consultant, his accounts

are historically rich and a good departure point. Nilsson, in *Pipes, Progress, and Poverty (2011)*, applies the dominant LTS theory to provide a general historical account of the development of urban water in both Kenya and Uganda. These accounts, though grounded in rich archival research, fall short ofunbundling the socio-cultural and political character of infrastructures as technical artefacts. Following on from David Nilsson's and Ezekiel Nyanchaga's works, I undertake to rewrite a social and political history of Nairobi's water and sanitation technology. The focus is on the conceptualization, financing, operationalizationand implementation of water and sanitation infrastructure and the nexus vis-à-vis the interplay by different actors, whether at the micro or macro levels. By focusing on certain dominant aspects within the STS debates, this study envisions and approaches the technical artefacts as socially and culturally constructed within specific contexts and timeframes, as well as examining the bottom-up initiatives such as people agency. How do locals fit into the ensuing matrix, especially where a deficiency and absence of networks are noticeable?

1.3.1 A Diagramatic Preview of Nairobi's Water Sources



Source: http://www.jambonairobi.co.ke/services/water-in-nairobi/water-supply-to-nairobi/3/

Figure 1: This diagram maps out Nairobi's waterscape in terms of sourcing and management.

1.4 Research Questions, Objectives and Hypothesis

In studying the evolution of Nairobi's water and sanitation infrastructure system, the key question is about the process and manner of accessing water and getting rid of waste water as two of the most critical infrastructural services for any urban space anywhere in the world. The idea that infrastructural artefacts of water and sanitation in Nairobi, as instituted in the colonial and postcolonial period, need to be contextually analysed from belowwas key to determining the main questions for this study. Asking the question of how making provision for water and sanitation has been mapped out in Nairobi since its foundation in 1899, with the goal of producing narratives of the daily experiences of the users, informed this undertaking not only as away of filling the historiographical gap that exists in the history of technology in Africa but also as a means of de-bracketing the Global South histories of urbanization. Specifically, this research seeks to historically unravel how various technologies have interplayed to reproduce Nairobi's water and sanitation landscape. The study also centres on answering the question of the nature, meaning and effect of water and sanitation technologies for Nairobi in relation to their adoption, contestation and localization.The study treated technology as a non-neutral entity that is embedded within society and whose process of production, deployment and appropriation palpitates contextually.

The main objective, therefore, is to provide an understanding of the development of Nairobi's water and sanitation scapes, locating the meaning, effect and use involved. This is against the backdrop of the inadequacies of the large technical systems (LTS) as a popular paradigm inSTS. Iunmask and explain the nature of technologies, as provided through centralized regimes in Nairobi, and, at the same time, capture the non-conventional approaches emerging out of the adaptability, localization, contestation, resistance, and rejection, especially on the fringes of the networked systems.Scholarship on the history of technology must give credence to the 'bottom-linked technologies' that emerge and thrive, especially in deprived areas of the Global South cities. The user or consumer is key to the process of the appropriation of technology, and the potential for most cities today lies in the devolved, decentralized, bottom-up or bottom-linked technologiesfor service provision. The purpose of this is to meet the goal of writing history that integrates the conventional top-down approach and the user agency from below. This leads to production of a history of technology that is representative of the

society, where the interaction of users and artefacts takes place to represent the complementary co-existence of the 'decentred' and centralized modalities of provision. Seeing Nairobi's landscape especially within the 'flexible settlements' as spaces of innovation, invention, and reinvention of technologies for water and sanitation, the people must be central to the process of migration and transfer of technology. Post-colonialism and coproduction provide the theoretical framework and perspective within which these objectives are realized.

The major hypotheses informing this study involve the recognition and acknowledgement that people as users have the ability to adapt, localizeand reject incoming technologies that have come to alter their social-cultural fabric. Technologies as artefacts are non-neutral entities. They are more often than not laced with embedded politics, informed by the scale of economics and the day-to-day politics of control, domination and livelihood development. The day-to-day experiences of ordinary people give the correct images of how technologies are constructed and mediated in the process of rendering them responsive to the needs and aspirations of their users. Another key hypothesis of this study is that there is potential in the 'bottom-up approaches' to the challenges of service provision and only a bottom-linked study in a multi-layered city like Nairobi can bring forth a representative understanding of the realities of the Global South and enhance the writing of inclusive histories of technology.

1.5 Research Methodology and Materials

The study employs an interpretative research design as it is aimed at historically presenting the formal urban practices of water engineering and sanitary planning, as well as the individual and group responses, practices, meanings, effects, opinions, attitudes and perceptions in relation to water/sanitation infrastructural development, especially within the informal areas of Nairobi. It targeted the African settlement areas of Pangani and Kibera within the colonial context, postcolonial Mathare, and 'informal settlements' in Eastland areas of Nairobi (refer to the map). These 'informal' areas were purposively sampled, though not exclusively, because, based on their fluid nature and conventional infrastructure deprivation, they became sites for most of the urban grassroot flows in survival and also carry most of the indigenous images on the urban

landscape. The Nubians in Kibera, as the oldest inhabitants of the city of Nairobi, were instrumental in providing key background information to the research. This was with the aim of capturing the day-to-day narratives of access to water and sanitation and exploring the contextual ideals of technologies of water and sanitation provision, especially through processes of adaptation, improvisation, hybridization, contestationand localization.

In-depth interviews, participant observations, informal discussions, photographing and subsidiary oral sources were utilised. In my use of oral traditions, I examined the 'verification approach',as explained by Peter .R. Schmidt. This is a methodological perspective which holds that oral traditions must be affirmed by concrete proof of their claims; that is, they must be verified before being accepted as reasonable sources.[58] This process of verification was done through the corroboration of sources to determine thereliability of the data given before being adopted for usage in the analysis. The process of triangulation and verification proved highly effective in testing the validity of most of the data attained orally.

Oral accounts (considered ideal for subaltern studies and also heavily relied upon in collecting historical data) of purposively sampled urban residents of informal areas (with special reference made to those who have lived in the city through its various epochs-colonial and post-colonial/post SAPs), urban planning practitioners, civil society groups, neighbourhood movements, social welfare groups, and development partners was also employed to supplement the archival sources. Archives provided both primary and secondary data. The oral sources were gathered through in-depth interviews that were conducted in Kibera for its long history that is as old as Nairobi itself, and the belief that having developed as a village model, it offers insights into bottom-linked approaches to the provision of critical services. Interviews were conducted in Mathare for the self-help efforts initiated either by land-buying companies into the early 1970s or the initiative by the Catholic parish that aimed to improve livelihoods; and Kariobangiv was used as a model of on-site and service settlement. Photos and voice recording were employed to gather data before being transcribed and analysed.

[58] Schmidt (2006), p. 27.

Archival sources were derived from the British National Archives at Kew, Richmond (London); the Kenya National Archive (KNA), Nairobi, the Bodleian Library of Oxford University, UK; and the Macmillan Library in Nairobi, which houses documents from the Nairobi City Council (NCC) dating back to the establishment of the municipal council in the early 1920s. More than six months of archival research was dedicated to the archives and libraries in Nairobi across a span of three intervals of mostly two months each. Four weeks were spent in the archives in London at Kew and a week at the Bodleian Library, Oxford. Most archival materials analysed included colonial reports from the early 1920s to 1962, special commissions' reports, especially on sanitation and water supply, colonial official communiqués to the colonies, correspondence from colonial officials, letters from individual officials, both administrative and engineering staff, diaries, photographs, maps, tender documents for the supply of engineering materials, consultancy firms reports, financial application documents, and other policy documents appertaining to sanitary and water supply issues. This archival research was used descriptively to establish trends or develop, approve or disapprove hypotheses in tandem with the research objectives.

Apart from the material from the archives, the library of the School of Oriental and African Studies (SOAS) in London provided an opportunity to conduct document analysis of the valuable data available in the form of reports, policy documents from several African countries, works of fiction that point towards urban materialities (e.g. *Going Down River Road* by Major Mwangi), magazines and World Bank and NGO documents. The British Institute in Eastern Africa Library (IBEA) and IFRA library in Nairobi provided the necessary literature and, of course, not forgetting the multiple secondary literature accessed electronically and physically at TU Darmstadt and the Institute of Civil Engineers, London. The online archiving of newspaper articles by IFRA came in handy and complemented the other sources employed.

The last stage involved the corroboration of the archival and oral sources against the available secondary literature. This was then thematically analysed with reference to content and against the backdrop of the identified theoretical perspective(s). This was done in tandem with the set objectives to develop a narrative that would represent the history and social political constructs of Nairobi's water and sanitation infrastructure

question. In developing this work, the focus narrowed to capture ordinary people's daily experiences, and juxtaposed them with the top-down ideals of provisioning and planning offering a contextual analysis.

CHAPTER TWO

LITERATURE REVIEW

2.1 An Overview of Literature and Infrastructure Debates

2.1.1 The Sanitary Movement in the 19th Century

A history of sanitation in its own sense is a story of the world's struggle for an adequate supply of potablewater, and its efforts to dispose of the resultant sewage without menace to health or offence to the sense of sight or smell.[59] In the realm of the city as understood today, it is important to acknowledge that the attempt to rid the city of its own filth has been a tempestuous journey, founded in planning, engineering and legal tussles.

The processes of advancement within societies go hand in hand with major social cultural and economic transformations in the general perceptions and practices of either individual or group. The aftermath of the industrial revolution in Europe and North America presented new challenges for city authorities and urban residents. Among these challenges, sanitation was of primary concern. As society faced pestilences that were connected mostly to the congestion witnessed in emerging urban spaces, medics and other practitioners sought to connect major illnesses to hygiene and sanitation.

Accordingly, the popularisation of 'miasmata' and later the 'germ theory of disease' in the second half of the 19th century saw hygiene and sanitation gain centrality in the struggle against illness and disease.[60] Prior to the 19th century, cleanliness was not prioritized and streets remained dumping sites for refuse. What accrued from this were high mortality rates as Europeans lived in an unhealthy milieu of filth, poor hygiene and non-existent sanitation. Bubonic plague, typhus, *variola* (small pox) and tuberculosis took a heavy toll on populations, both young and old.[61] Medical historian Howard Wilcox Haggard captures the sense of ignorance and the laxity towards personal hygiene during this period by asserting that refuse from the table was thrown to the floor to be eaten by the dog and cat or to rot among the rushes and draw swarms of flies

[59] Cosgrove (1909), p.2.

[60] Faria (2002), pp. 121-125.

[61] Ibid.

from the stable.[62] By acknowledging that poor sanitary conditions were a recipe for killer diseases whose control proved expensive, authorities sawthe need to institute major reforms that would guide the disposal of waste and the handling of wastewater. Some of these reforms were necessitated by developments in the field of science and technology.

The squalid conditions in urban areas of 19th- century Europe which was occasioned by massive industrialization, brought about epidemics that forced governments to deal with public health, at least from crisis to crisis. As espoused by Martin V. Melosi, experience became the best teacher.[63] On this front, the efforts put in by Edwin Chadwick went along way to setting in motion realistic approaches of achieving sanitary cities and neighbourhoods from a miasmatic point of view. Sir Edwin Chadwick's collaboration with Dr. Thomas Southwood Smith and John Stuart Mill led to magisterial improvements in public health in the Britain of the early 19th century. As an expert in Poor Law reform, Chadwick confronted municipal officials with a commitment to tilt the state of affairs to what he believed was a panacea to the deplorable conditions in British industrial cities.

According to Mervyn Susser and Zena Stein, Chadwick in his relative youth was greatly informed by technical innovations in epidemiology and the statistics of the early French hygienists, and not least by their emphasis on the quality of the social and physical environment. He learnt much from Villermé, in particular, and from Parent-Duchatelet, and corresponded with both (though none of these two French scholars believed in miasma theory).[64] Chadwick's analysis,as portrayed in his report in terms of approach, was greatly influenced by his ongoing worksin France, where hemaintained a close correspondence on grappling with the enormous task of the investigations he had undertaken.[65] The metanarrative in the referred to approach by the French hygienists was the causal assumption that poverty caused disease; disease was costly to society and to prevent disease, one must alleviate poverty.[66] Above all,

[62] Haggard (1989).

[63]Melosi (2008), pp. 28-39.

[64]Zusser and Stein (2009).

[65] Chadwick (1842); republished 1965; Lewis(1952); La Berge (1988; 1992), Finer(1970), Hamlin (1998).

[66]Zusser and Stein (2009).

Chadwick adopted the utilitarian social engineering approach of his mentor, the influential philosopher Jeremy Bentham,[67] with whom he had served loyally under, on the front of the reform of the Poor Laws.

As Lynn M. Zottobserved, the watershed text that emerged from official explorations into the environs of the poor was Chadwick's *Report on the Sanitary Condition of the Labouring Classes of Great Britain (1842)*, which compiled the findings of Poor Law doctors throughout England and Wales. As part of his *Sanitary Report*, Chadwick called for dramatic social improvements and changes to the nation's infrastructure, including improvements in sewer drainage and the water supply, methods for garbage removal, and better ventilation as part of building design. In newspapers and magazines across the country, Chadwick's programme for public health was discussed and debated, with many concluding that sanitation reform was the best and only way to address the social ills of the lower classes. Sanitary conditions would not only halt the spread of disease, but also obviate the need for large-scale charity measures, as the poor, no longer oppressed by dirt and illness, would be better able to fend for themselves. In short, public health would not only benefit the poor, it might even reduce the number of destitute.[68] Chadwick, the man who became the embodiment of the sanitary movement and its ardent defender, believed that the nostrum for the menacing disease in urban areas lay in eradicating the sources of miasma arising from the unhygienic habits and filthy living conditions that were characteristic of the poor.[69]

In 1848, a new wave of cholera was sweeping westwards across Europe. By June, an epidemic was raging in Moscow and by September it had reached Hamburg and Paris. Watching its spread with anxiety, the British government, after several failed attempts, passed the Public Health Act on the last day of August 1848, establishing a General Board of Health for a provisional five-year period.[70] With the Public Health Act of

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[67]Ibid.

[68] 'Nineteenth-Century Sanitation Reform – Introduction' Nineteenth-Century Literary Criticism Ed. Lynn M. Zott. Vol. 124. Gale Cengage 2003 eNotes.com 13 Dec, 2016 http://www.enotes.com/topics/nineteenth-century-sanitation-reform#critical-essays-nineteenth-century-sanitation-reform-introduction

[69]Zusser and Stein(2009).

[70] Elizabeth and Theodore (2005),accessed athttp://dx.doi.org/10.1590/S0042-96862005001100017

1848, Chadwick's ideas began to be implemented in Britain.[71] The enactment of the LW was 'the beginning of a commitment to proactive, rather than a reactive, public health'.[72]

Despite the recommendations by sanitarians receiving utmost popularity and goodwill from local leaders, practitioners and policy makers, the contrary belief that it would be ineffective, or that implementation of such drastic programmes would require burdensome taxes or it would interfere with personal liberties garnered many advocates.[73] They used the press to register their misgivings about Chadwickian principles. In 1848, *The Economist* published an article heavily criticising attempts to try public sanitation, as demonstrated in this excerpt;

> Suffering and evil are nature's admonitions; they cannot be got rid of; and the impatient attempts of benevolence to banish them from the world by legislation, before benevolence has learned their object and their end, have always been more productive of evil than good.[74]

The opposition and scepticism came from both high profile individuals and groups who preferred the status quo in cities like London. Theysaw the new changes as expensive and draconian. In a letter to the *Morning Chronicle*, a Londoner, anonymously identified as 'Rate Payer', provided scathing and sceptical views on the 'centralising' tendencies of the Public Health Act, noting that;

> Even in Constantinople or Grand Cairo where plague and cholera are decimating the population, it is doubtful whether such a Bill would be desirable.[75]

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[71] Headrick (1988).

[72] Hamlin C, Sheard S. Revolutions in public health: 1848 and 1998? *British Medical Journal*, 317, pp. 587-591

[73]Ibid.

[74]*The Economist*, May 1848 in Hamlin (1998).

[75]*Morning Chronicle*, 29 April, 1848 in Hamlin (1998).

Despite the opposition, the passion and non-compromising position adopted by Chadwick,who was supported by medical researchers, the most prominent of which included Florence Nightingale (1820–1910), resulted to reforms being instituted across England and Wales. This included progressive pipe-based sanitary systems. Nightingale, a social reformer, a statistician, and the founder of modern nursing, became a great voice in the belief in miasma theory and an ardent opponentof the 'contagionists'. Edwin Chadwick, in the early years following his 1842 report, patronised sanitarianism with the support of loyalists amongst doctors, engineers and local government practitioners.

The Royal Commission on Health of Towns (1844–1845), which had tacitly accepted Chadwick's agenda, distanced itself from what was referred to as the 'messy social and moral issues' of the 1842 report by switching their attention from the condition of the labouring population to the health of towns.[76] It now appealed to the middle class municipal improvers, whose efforts had previously been little concerned with the state of the masses but, on the contrary,focused on that of the streets in which they themselves lived and worked.[77] In this way, according to Hamlin, an easily justifiable and relatively uncontentious restriction on the scope of a single inquiry shifted the focus of public health to municipal engineering and local government.[78]

E. P. Hennock observes that whenever a town has succeeded in tapping a larger supply of water, its drainage becomes a more acute problem. Water closets were emptied into sewers designed for surface and wastewater. Older forms of sanitation had belonged to a household economy where water was available only with much labour. Households, therefore, did not use the quantities of water that they were to do later, and human waste was mainly disposed of separately from wastewater. The demand for a larger water supply, when it came, frequently stemmed from local industry and came about through the influence of local manufacturers on municipalities.[79] The analysis drawn from this case is that sanitary arguments served at best to support a case made

[76]Hennock (2000).

[77]Ibid.

[78] Hamlin (1998).

[79] Brown (1988).

primarily for economic reasons.[80] It is imperative therefore to mention that although sanitarians used pestilence as the central cog in their demandforimproved waste disposal mechanisms for cities, water supplyand sewerage systems assumed economic ends in an expanded purview of the need for radical forms of reducing environmental pollution from industrial wastes.

Before the provision of a central water supply and sewerage system, traditional forms had undergone certain improvements. Cesspits, being the most persistent technology for sanitation at the time, underwent major makeups by receiving brick-lining, reduction in size, minimised stench by the application of various materials to absorb moisture and also frequent emptying as responsibility moved from house owners to municipal authorities.[81] Later on, cesspits started being replaced by tubs and pails, which could be removed in a sealed state to a depot to be emptied there and washed before being re-used, and by the use of various materials to absorb moisture and reduce odour.[82]

It goes without saying that the use of excreta as fertilizer for agricultural production was a common practice. These old systems of excreta disposal by collection of dry matter from cesspits were simple despite the nuisance of odour and the elaborate systems favoured by sanitarians promised to channel the collectivised wastewater to riparian fields for fertilizer production. However, this was not to immediately happen as towns constructed sewers that poured their contents into local rivers, thereby compromising the health of downstream communities. On a larger scale, it led to major health crises as characterised by the 'great stink of London', resulting from the Thames being chocked with raw sewage. Increasing use of water closets and the implementation of the water carriage system, as Melosi writes, redirected pollution problems away from households and into rivers and streams.[83]

It took more engineering expertise to solve the question of sewage treatment before being released into water channels. Joseph William Bazalgette, who rose to

[80]Hennock(2000)

[81]Ibid.

[82]Ibid.

[83]Melosi (2000)

prominence after the passing of the Nuisance Removal Act of 1855 that established the Metropolitan Board of Works to develop an adequate sewerage system for London, proposed a series of main intercepting sewers, which ran west-east to catch discharges before they entered the Thames.[84] Technical know-how combined with legislative shrewdness became the two critical forces that drove the sanitary movement in Europe.

Despite expressions of misgivings on the centralised and large-scale sanitary systems launched in most towns and cities in England and its dominions, the English sanitary movement attained a broader scale of publicity that went beyond Britain. As the 19th century witnessed a lot of efforts being dedicated to developing sanitation and water provision systems that assured security from pestilence, the need for scientists, policy developers, reformers, local authority agencies and engineers to meet and share, disseminateand exchange ideas was great. The first International Sanitation Conference was held in Brussels in 1852, and the 1876 *International Congresses on Sanitation and Demography* initiated a series of meetings.[85] It gave British sanitarians an opportunity to make their views known, one that they were quick to seize.[86]

Following the elaborate systems instituted in England that were highly publicised, especially with the cholera threat sweeping across Europe, the sanitarians won an immense following in most European cities amongst administrators and local governments. In Germany, as Hennock notes, where British engineers had already been active constructing gas and water works for private companies, the best-known reaction was that of the city of Hamburg. After a serious fire ravaged the city in 1842, the authorities in Hamburg commissioned William Lindley, a British engineer working in Germany, to provide a public water supply. Itfollows that rather than disease being the causal agent for adopting new systems, the risk of fire was making many cities and towns consider constructing public water systems. Under Lindley's influence, therefore, Hamburg seized the opportunity offered by the necessary reconstruction of

[84]Ibid.

[85] Hard and Oldenziel(2013), p.69.

[86]Congrésgénérald'hygiéne de Bruxelles, session de 1852 (Brussels, 1852). See F. O. Ward's presentation of the 'new English sanitary system' at the plenary session, the detailed discussion in the section dealing with sewers and privies and the response to this in the revised text of the resolutions on the subject (pp. 29-32, 95-104, 143-149, 240-243).

so much of the city to construct a central sewerage system that was operationalized in 1853, making it the first city in Germany to do so.[87]

The city of Frankfurt benefited more from the efforts of Georg Varrentrap, a local physician, who had visited England in 1847 and 1852 at the height of the sanitarian movement, making him much versed with the debate and considerations.[88] After deliberations on the value of adopting such systems as instituted in England, a commission of experts charged with the responsibility of making recommendations sanctioned the construction of a small water-bore flushed drainage system. After slight delays resulting from the annexation of the city by Prussia, the drainage system was operationalized in 1868. Berlin was more hesitant, having failed to send even one sanitary expert to the Brussels Congress, and despite taking several officials on familiarisation trips to London, Paris and Hamburg, it was not until 1873 that it instituted a piped sanitary system.[89]Other cities in Germany followed the same pattern, with Danzig having completed their sewerage system in 1871, Breslau in 1877 and München,and Köln in 1881.[90]

In the Danish capital of Copenhagen, the sewers were constructed in 1857 and improved in 1860 and 1885 so that wastewater and surface runoff were channelled into the harbour. Further health concerns necessitated the reworking of the sewers from 1893 to 1903.[91]Over the same period,starting from the 1860s, the same technologies and approaches to sanitary challenges in cities diffused tothe US's major cities, such as Chicago, Boston and Philadelphia.[92]

At the end of the 19th century, the European colonies got sewerage systemsfor the same public health reasons, but at later dates than in Europe.[93] During the first decade of the 20th century, the sewers of Calcutta, the then capital of British India, were

[87]Hennock (2000).

[88] ibid

[89] ibid

[90] Seeger (1999).

[91]Hennock (2000).

[92] see Smith (2013).

[93]Chaplin (1999).

constructed.[94] The first sewers of Pondicherry, the main city of French India, were built in the 1930s, but drains had been constructed in the 18th century and a law on waste dumping implemented at the end of the 19th century.[95] India would become an important reference point, serving as a template for the implementation of major infrastructure, including sewerage systems, in the other colonies. Spatial inequality in urban infrastructure development and the strong bias in quality service provision, skewed towards certain zones of the city, has seen postcolonial historiographers and sociologists locate the inadequacies of the systems in the colonial past of the Global South. As technologies travelled from the metropole to the dominions or colonies in this case, their adoption and implementation presented a different imagery from that of Europe and North America. The water and sanitary systems adopted bythe colonial milieu in the colonies, like many other infrastructure developments, revealed intended or unintended deficiencies, inadequacies and differentiations, as manifested in the skewed nature of their deployment. Despite their purpose of dealing with pestilence in the form of plague and cholera outbreaks that ravaged virtually all cities in the colonies at the latter half of the 19th century and beginning of the 20th century, sanitizing cities meant characterizing indigenous and Asians in the case of the African colonies as 'diseased societies', yet the water and sanitation systems failed to provide a universalized model of access.

Erik van der Vleuten explores the aspects of the 'ideology of circulation', which connects the infrastructural integration of peoples with economic and ideological exchanges in the service of joint progress, democracy and peace, and, most importantly, the analysis of the implications of infrastructural changes to the economic or political agendas of powerful elites (imperialists and colonialists in this case for the colonies) for their own benefit.[96] However, I would argue that while in Europe LTSs may have had the objective of homogenizing the city, solving existing problems in transport, water, energy, and sanitation, in the colonies, these models, instead of having just a utilitarian value, stand accused of possessing motives of promoting racial segregation, atavistically anchored in beliefs of European superiority and reinforcing

[94]Gupta (2006).

[95]Fardin (2014).

[96]der Vleuten (2004), p. 1.

the notion of Europe's civilizing mission. Was racial segregation a conscious goal of system builders within the colonial context and what implications did this have on the indigenes either trooping into or already settled in the urban locations of the Global South?

Carole Rakodi correctly states that colonial powers used and developed the planning ideas, standards, and engineering technologies that had been invented to meet the requirements in Europe.[97] An analysis of the emergence of LTSs and their implementation by system builders in cities in Europe points to incidences of unevenness either in connectivity or in the quality of the supply network. For example, London had a dual system of water supply from the Thames, whereby the lower supply system connected to low-income areas of the city while the other network, which had greater reliability in terms of pressure, linked the high income and industrial zones.[98] Such spatialization would replicate itself in the colonies, though characterized basically by race rather than class. The popular view has been that the engineering practices in the Global South deliberately or consciously intervened to reorder the infrastructure geography and the social map of the urban areas to perpetuate a system of 'spatial apartheid'.[99] This view needs to be examined further' either as a way of expanding Global South infrastructural and area studies or as a means of revising the grey area that exists in the contemporary scholarship.

For writers like Headrick, the advent and consolidation of European empires together with the arrival of modern technology in the mid-19th century was a monumental moment. It was at this point that technology provided the 'tools', first for the creation of overseas empiresand second for their management and exploitation.[100] It is against this backdrop that large technical systems (LTSs) were rolled out in the colonies. At the same time, as cities grew to assume new roles as colonial government capitals, they had to be remodelled to a standard that would provide a 'home away from home' for the colonial officials and their families. Under the French assimilation policy in West Africa, Dakar in Senegal had to be a 'small Paris' if not Paris itself. Furthermore,

[97]Rakodi (2008).

[98]Tarr and Dupuy (eds) (1988).

[99] Monstadt and Schramm(2017), pp. 104-125; see also Coutard (2008); Gandy (2006)

[100] Headrick (1981).

colonies constituted new frontiers for the application of new models in technology and the introduction of those already in practice in Europe.

Within the realm of urban studies, there has been a longstanding argument that for imperial Europe, the colonies were laboratories where new models in technology would be tested. David Arnold gives credence to this assertion by arguing that in recent times, colonies and ex-colonies provided overseas laboratories and testing grounds, places where dangerous experiments could be conducted or ambitious schemes of social and physical engineering enactedwithout the public scrutiny and political constraints that might inhibit or even prohibitsuch ventures in Europe itself.[101] Africa, as ofthe late 19th and early 20th centuries hence found itself under new engineering and planning practices that would change its urban spaces completely. The city in Africa became one such 'laboratory' or frontier.

Although that which was popularized in the 19th century by advocates of the sanitary movement, with Chadwick as the lead proponent, was seen as a solution to the problem of water and sanitation in the cities of the emerging polities in Europe and further replicated in America with little tinkering, it ended up serving and protecting the interests of the 'better off'. Large systems of water and sanitation seem to have evolved beyond their vision as mere public amenities into becoming instruments for social differentiation, which responded mostly to the needs of the advantaged dwellers within city spaces. Arguably, the new technical achievements in developing early water supply proto-systems had some bearing on levels of consumption in the early 19th century and the new systems did not provide for equity of service.[102] Mikael Hård and Ruth Oldenziel observe that a critical analysis of many actions by scientists and engineers reveals that they were not aimed at improving the welfare of the proletariat but rather at protecting the interests and investments of the middle class. 'Instead of making the proletariat cleaner, running water increased the comfort of the better off classes.'[103]

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[101] Arnold(2005).

[102]Melosi(2008).

[103] Oldenziel and Hård (2013), p.66.

Mathew Gandy is of the view that the first half of the 19th century was marked by a deterioration in urban living conditions punctuated by devastating outbreaks of infectious diseases.[104] The rapid growth of cities quickly overwhelmed the historical reliance on wells, water vendors and other sources, and led to the introduction of centralized water supply systems in, for example, Paris in 1802, London in 1808 and Berlin in 1856. However, the question of the financing of these projects arose.In the British colonies, the Manchester doctrine adopted in Britain curtailed expenditure on major engineering solutions.In Paris, new legislation in 1894 made the connection between individual dwellings to the main drainage system mandatory. In the Global South, this last phase of modernization of water infrastructure remained only partially completed. Neither comprehensive sewer systems nor water treatment works were ever introduced. The result here was the skewed nature and class-biased provision of city services that continues to be perpetuated there. Mathew Gandy proposes that exploring the history of water infrastructure beyond the metropolitan core of Europe and North America can uncover fresh insights into the limitations of the 'bacteriological city' as a universal model and also disentangle some of the political tensions underlying the introduction of technological networks in the capitalist city.[105]

It is important to note that most countries hesitated about adopting the systems as they were in England in the pioneer years due to the debates on the pollution of rivers and the legal tussles based on rights and vested interests. In some places, the traditional improved systems of cesspools were favoured compared to the cost of the new systems. The use of pneumatic pumps for the purpose of emptying cesspits had seen them survive for longer in Germany than in England, where ashes had been used to dry the excreta.[106] Furthermore, when a town embarked on a main drainage system, it began something whose cost greatly exceeded what the authorities were accustomed to spend. It becomes imperative to highlight that a sanitary infrastructure of a centralized water supply and main drainage was the luxury of communities that were rich.[107]

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[104] Gandy (2006).

[105] Ibid.

[106] Hennock (2000).

[107] Ibid.

Deriving from the sanitary movement, cities and towns had the benefit of knowing the actual connection between sewage and the sources of drinking water, for example, the adverse potential impact on their health or welfare. That knowledge resulted in great strides being made in collecting and conveying sewage away from people's homes, and in treating the sewage prior to its discharge either from their source of potable water or at a point near their source.[108] The impact of the new system of sewers on mortality rates remained debatable yet it was recognized as mostly substantial. JorgVögele through his work, *Urban mortality change in England and Germany 1870–1913,* provides a demographic comparison that shows the remarkable decline in death rates in the 1860s in English towns while in Germany, a common pattern of decline is only registered from the 1880s. The steady decline in mortality rates in German towns in the last quarter of the 19th century is attributable to the adoption of sanitary measures along the English model.[109] Hence, while epidemiological dangers and aesthetic problems associated with substandard sanitation and drainage were at the centre of the adoption of the new systems, fire prevention as shown by the Hamburg casealso played a major role in instituting pipe-bound cities.[110] The purpose of curbing mortality rates and bringing them down through sanitary measures had to be coupled by that of securing the economic base of such cities from the devastating risk of fire by adopting strategic water supply mechanisms.

Also, it is important to note that the success recorded in improved health for most cities by the period marked by the end of World War I cannot solely be attributed to the efforts of 19thcentury sanitarianism. Other emerging technologies like the introduction of motor vehicles had a ripple effect on sanitation. This is because the vehicles as a mode of transport phased out the use of animals such as horses, oxen, and donkeys. This eliminated or reduced the volume of droppings.[111] As a result,the number of flies as carriers of pathogens or disease vectors was also reduced, resulting in a massive decline in mortality rates.

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[108] Giovanni et al. (2014), www.mdpi.com/journal/sustainability

[109]Vögele (1998), p. 166.

[110]Luckin (2000).

[111] See McShane (1994); also see Schultz and McShane (1978)

2.1.2 The STS/LTS Debate

As Renate Mayntz and Thomas P. Hughes noted, social science research has long focused on the development, diffusion and, in particular, the consequences of specific isolated technologies or technical artefacts.[112] The existence of complex and ubiquitous technical systems has caught the imagination of many researchers. This has resulted in ongoing debates that centre on the socio-technical character of LTSs, and their transfer, appropriation, conflict and contestation. Historians of technology have sought to analyse how these systems develop not only as technical artefacts but also in their social nature as they acquire functionality among users. More often than not, these technologies in their 'largesse' spurn out into networks at a spatial and organizational level.

However, it is the risks of failure and disaster, negative externalities, management, coordination and control problems associated with the development of LTSs which have necessitated historians and social scientists to co-operate in the analysis of their development and functioning.[113] While the attention given to large technical systems and the subsequent interdisciplinary approaches has seen remarkable success being made towards the production of knowledge in the realm of science, technology and society studies, the LTS/STS debate has for a long time perpetuated the marginalization of the ordinary technologies of everyday life, especially for the non-elite class of society.

Hughes' publication, *Networks of Power (1983),*set into motion unprecedented interest in the study of large technical systems as socially constructed ones and how they function in modern society. Hughes became the 'the father of LTS' and his phenomenal work attracted diverse attention that can be argued to have given science and technology studies a new lease of life. The starting point of Hughes's historical reconstructions, both in the sense of the initial research interest and of the elementary building block in what would later become the edifice of LTS, are successful investor-engineers.[114] Hughes describes the origin of LTS, and their transfer to specific

[112]Mayntzand Hughes (eds.) 1988.

[113]Ibid.

[114]JoergesBernward in Mayntz and Hughes (eds.) 1988.

technologists which he identifies as ‘inventor-entrepreneurs’, ‘independent professional inventors’ or ‘system builders’.[115] While Hughes’ elaborate and didactic presentation of the evolutionary progression of technical systems provides a strong basis for understanding how technologies develop and work within society, his uni-linear assumptions of development require a more insightful interrogation. It can be said that the LTS perspective as espoused by Hughes (1983) presents single narratives where one group of actors, the ingenious technologists, is herofiedand the large technological systems allocated autonomous and deterministic power to always chart a forward looking development by virtue of what he calls ‘momentum’. This kind of analysis closes one eye to the interplay of opposing forces and socio-economic and political tensions that inform the character of technological development. Much as this kind of research marked a turning point in augmenting STS focus, it has retrospectively contributed to the bracketing of some societies and sometimes the alienation of the pivotal role that users play in the development and appropriation of technologies. Jorges observes that users of LTS are passive users. Their discipline and their active contribution, and, by the same token, their potential resistance, are rarely made explicit. The co-production of system services is not explicated in LTS researchas the users remain hidden, most of the time, behind abstract concepts such as demand or risk or regulation.[116]

In line with the ambiguity associated with what constitutes ‘large technology’, metaphors like ‘small is beautiful’ capture many people’s belief that happiness is not a matter of largeness, especially not with technical systems.[117]Jorges states that whatever we take to be large, that which is vaguely construed out there as large seems to be unsatisfactory as a delineation. Any differentiated reconstruction of the views of actors concerned with a particular system will show this.[118] The level of complexity may vary in scale at various levels of analysis or production. While the user may not comprehend how large the system could be as he or she interacts with the technological materialities, the engineering designers may see it as a complex system at a technical level while politicians and government operatives may tend to concentrate on the financial and

[115] Hughes (1983)

[116]Jorges (1999).

[117]JoergesBernward in Mayntz and Hughes (1988).

[118]Ibid.

legal complexities of the system's adoption and implementation. As for investor-entrepreneurs, the complexity might arise in the form of the cost of implementation or operationalization vis-à-vis investment returns via a system of cost-benefit analysis. The bottom-lineis that LTS studies remain inconclusive in capturing the specific technological aspects of socio-technical development and usage.

E. F. Schumacher, one of the proponents of 'small is beautiful' in his publication by the same title – which interestingly came out ten years prior to Thomas P. Hughes' magisterial work – asserts that technology recognizes no self-limiting principle in terms, for instance, of size, speed or violence. It therefore does not possess the virtues of being self-balancing, self-adjusting and self-cleansing.[119]However, I would assume that this does not imply that technology exhibits neutrality.

Though Schumacher's analysis is more focused on the economics of everyday life, he warns, 'to go for gigantism is to go for self-destruction'. His views on technology contradict those held by the Hughesian school in many respects. While contemporary scholarship need not romanticize smallness, the need to re-examine technologies as tools of everyday life must reign supreme. This constitutes part of my objective to refocus this study of Nairobi's infrastructure systems of water provision and sanitation access through an integrated approach – both bottom-linked or 'decentred technologies' and centralized large technical systems – so as to give voice to smaller technologies emerging and sustaining off-grid localities in the urban-scape, which operate outside the luxuries of centralized large technical systems, be they public or private.

With the focus of scholarship around technologies and infrastructures shifting from 'images of things' to Edmund Husserl's philosophical injunction, 'to the things themselves',[120] the belief is that the unpacking of artefacts provides deeper insights into the functionality of technologies. By focusing on technological systems as artefacts that derive from socially contested spaces, and are hence non-neutral, STS helps in providing a lens to unpack and unbundle them to manifest their multifaceted and multilayered nature. If Hughes' LTS bestowed unto historical studies of technology

[119] Schumacher(1973).

[120] Langdon (1980).

the‘systems’ perspective, linking the apparatus to engineering systems and, in turn, linking these to manifold organizational, economic and political actors and structure, then social constructionist theorists of technology broadened the scope of analysis by understanding technological things as embedded within society and loaded with meaning. Technologies might not only be ‘means to ends’, they could also be ‘ends of means’. They shape society as well as being shaped by society. They are mediated and negotiated upon as not only technical artefacts but also as socially engineered.

Things encapsulate multiple notions of various actors and, hence, situating them in their right contexts capturesthe intricacies that surround their development and usage, forms of representation and embedded characteristics of a political nature. This helps us avoid the Hughesian heroism of ‘engineer-entrepreneurs or system builders’ and the black boxing of artefacts as self-driving, self-regulating and forward-moving. As Eduardo Aibar and Wiebe E Bijker’s work on the Cerdà plan for the extension of Barcelona reveals, closure around a final design resulted not from a simple power equation of who had the loudest voice, but from a set of situationally specific compromises resulting from a set of micro-struggles over the width of streets, the depths of buildings, and the provision of, and public access to, social facilities and parks.[121] By treating the city as an ‘enormous artefact’ in which the social and technical are heterogeneously engineered by a range of competing actors and institutions, Aibar and Bijker were able to escape notions of ‘technological impact’ that tend to frame discussions on urban technology.[122] Furthermore, their research shows how competing and contrasting visions of engineers, architects and local communities encompassed overlapping discourses of hygiene, mobility, economic growth, social distinction, land ownershipand occupation rights.[123]

Brain sees the STS perspective as helping illuminate how producers of cities, for example, architects, ‘make sense with things’ as ‘practical operators’ rather than simply reflecting the logic of abstract economic system.[124] This becomes a reality by shifting from the generalities of technology as a subject of reference and the human interaction

[121]Aibar and Bijker (1997).

[122]Coutard and Guy (2007).

[123]Ibid.

[124] Brain (1994), p. 218; Coutard and Guy (2007).

with *things* to the contextual and 'post-contextual' analysis of technology that is in undated with socio-cultural constructs. Urban materialities embody aspirations of various actors in a network but, as Brain states, its engineer sociologists define both the characteristics of the artefact and the social universe in which it is to function. STS hence unravels 'what social relations, institutional practices, strategies of action, and possibilities for transformation are built into cultural artifacts'.[125]Coutard and Guy point out how the STS perspective, broadly construed, emphasizes the ambivalence inherent in all technologies and the significant potential of the contestation of, and resistance to, technology – supported forms of discrimination, the deeply contingent nature of the process of 'socialization' or the appropriation of new technologies and their uses – affect the social 'effects' of new technologies.[126]

While STS studies have been important in offering a wide platform on which we analyse technological artefacts or 'things' in general, the over-reliance on the 'ideal planning'principles of the city either completely excludes the non-formal or small-scale mechanism of survival and organization within the city. Furthermore, despite centring the sociology of technologies, the STS perspective still bestows the utmost power to the engineering sociologists, hence promoting 'the autonomy of things' that is at the core of Hughes' argument. Despite addressing the ambivalent nature of the city and its tentacles represented in the form of its technological body, STS remains a top-down approach that has not focused on producing inclusive narratives of technology and technological processes. Retrospectively, while proponents of actor network theory (ANT) such as Latour acknowledge the role of actants,[127] the South has continued to be bracketed within the same theorization due to the privileged position of the North as the centre of scientific knowledge.

2.1.3 TechnologyTransfer and Colonization in Africa

David Arnold observed that works on the history of technology have been weak analyticallycompared to other subfields of history, specifically economic history, agrarian historyand environmental history or the history of medicine. Part of the reason

[125] Brain (1994), p. 216.

[126]Courtard and Guy (2007).

[127]See Latour (2005); see also the ANT Resource Website at http://www.lancs.ac.uk/fass/centres/css/ant/antres.htm

is that these subfields have managed to bring their own methodologies and agendas to the discussion of technology. They have also continued to receive better funding, thus, enabling them to undertake huge projects in terms of research and the production of knowledge.[128] As for the inertia in developing a history of technology in the South, Arnold indicts the traditional approaches to research. First and foremost, by equating technology with industrial technology as it has evolved in Europe and North America, the establishment of modern technology in Africa and Asia has been seen as primarily a legacy of colonial intervention, a boon bestowed by technologically advanced civilizations on societies considered 'backward' and even 'primitive'. By promoting such prejudices, indigenous technologies have ended up being excluded and devoid of their agency. The other approach has been to see technologies as having diffused from Europe to Africa, Asia or the Americas without significant local input. The indigenes are painted as passive recipients. As the 'travelling technologies' were characterized as progressive, modernand largely benevolent, their failure could only be as a result of local populations' stubbornness or misguided rejection, their failure to acknowledge the usefulness of the new technologies or local physical conditions that militated against their effective use.

Part of the reason for the promotion of such bias in the history of technology in relation to non-elite societies or the colonized is not only a problem of the colonies but the age-old practice of recording the history of 'great wars', 'great men', 'life changing or breakthrough inventions', and 'great machines' amongst many other grandiose ideas, events or projects. Oldenziel and Hård in *Consumers, Tinkerers and Rebels* amplify how technological innovations rarely produced the uniform experiences of Europe and that the main point is to acknowledge that in the process of appropriating technology, networking, tinkering and tweaking were necessary activities. The story of 'technologies-in-use and the people who used them'[129]offers a level ground on which to render an insight thatprovides a vivid understanding of technology, society and the lived experiences of day-to-day livelihoods. Instead of having a uni-linear narrative of invention, innovation and technology transfer that result from the asymmetrical analysis of technological artefacts, the counter-narratives of adaptation, conflict, contestation,

[128] Arnold (2005).

[129] Oldenziel and Hård (2013), p. 7.

improvisation and basically tinkering by consumers and users as active recipients put scholarship into the realm of a history of technology that is more rounded than is currently constituted.

To refocus attention on the relationship between the metropole and the colonies, Daniel Headrick promotes the central thesis of technology as 'tools of empire'.[130] European imperialism was partly a result of technological advancement asit made it possible to conquer, subjugate and establish hegemonic control over the new territories. Once established, the massive rail roads instituted in the colonies basically enhanced the movement of soldiers, European administrators and economic exploitation that leeched the colonies for Europe's economic development, under-developing the colonies in the process. The maxim gun was a symbol of European might that subverted indigenous communities sometimes into willing subjects. Advances in medicine, such as the production of quinine, did not just ensure the conquest of the tropical territories by controlling malaria. Narratives of how jigger parasites and other biological weapons were released by European colonialists to weaken resistance by local communities and increase misery have also emerged to put into perspective the role that technology played in the building of European overseas empires. After conquest, western technology served the purpose of promoting domination over indigenous societies, derogatively referred to as 'natives' and mediate the process of cultural imperialism described as the 'humanistic civilizing mission of the colonized'. European notions of superiority were promoted at the expense of all local initiatives at a technological level in what Betwell Ogot sees as blatant refusal to acknowledge the role played by indigenous societies in shaping not only their own history but also global history.[131]Ogot emerged as one of the leading nationalist historians in Africa in the 1940s, who pioneered what is widely known as the 'history of peoples of Africa'. He did this through a methodological revolution by employing and asserting the place of oral traditions in capturing the African agency, especially during the pre-colonial and colonial period.

[130] Headrick(1981).

[131]Ogot (2009), pp.1-22.

Michael Adassums up the perception of the European imperialists by stating:

> '… so much was new and strange in the overseas lands they visited in the early stages of expansion that Europeans often simply overlooked tools and methods of cultivation (read indigenous technologies). Cities and housing, public works and armies, and the way the inhabitants dressed and the products they offered in trade had greater impact on European attitudes than their distinctive techniques of construction, the killing power of the weapons with which they fought their wars, and the quality of the looms on which they wove their textiles.'[132]

However, much as the experiences of the indigenes were pushed to the periphery in the face of European imperialism, what is missing in Adas' and Headrick's analogies of technological imperialism is the question of how some local communities were able to tinker with some of the incoming technologies to their advantage, for example, as gun repairers and scrap metal dealers, doing artisan work that exhibited high skill levels. For instance, the Nandi warriors in Kenya put up one of the fiercest resistances to colonial establishment in Africa not only by using their indigenous weaponry but also by vandalizing and stealing railway and telegraph materials to make strong spears, arrows and bows, which they used against the invading British military.[133] Hence, it is not always that new technologies were received in colonies with bewilderment and meek acceptance.

To broaden the scope of understanding aspects of technology transfer and interaction, it is also important to aver that Europe has long looked overseas for opportunities for technological experimentation and development that were not feasible in Europe itself.[134] Colonies, and their successor states in Africa, Asia and Americas provided career openings for engineers, agronomists, doctors and technicians for well qualified

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[132] Adas (1989), pp. 32-33.

[133] Ochieng' (1983).

[134] Arnold (2005).

women and men, opportunities that were often lacking or very restricted in Europe. Colonies were ideal as overseas laboratories and testing grounds due to the absence of public scrutiny and political constraints or basically weaker laws governing such risky undertakings. Perhaps confronted by the new industrial technologies of the high imperial era where 'machines became the universal measure of men', the question that lingers is how far these 'big' – one might say'heroic' – technologies, so emblematic to the imperial eye and so often commanding state resources and prestige, actually mattered to the local populations.[135]

Arnold continues to lament the growing distrust of sweeping generalities across time and place of earlier, seemingly simplistic typologies, with their unsubtle (or worse unfounded) distinctions between 'colonial' and 'indigenous', their tendency to treat colonialism as an undifferentiated whole, and their disposition to see technology as an instrument of power relations rather than as a cultural space in which various forms of interaction and exchange, of mimesis and reversal become historically possible.[136] Arnold's submission that is useful for our analysis is his emphasis on the centrality of users/recipients of technology from Europe in the study of the history of technology in the Global South. However, despite the proposed need for zooming in on the meaning, useand effect of technologies as they travel and are appropriated within new frontiers, the study of technology in the Global South must be able to locate the role of indigenes as innovators, inventors and independent users who possess the ability to adapt, rejectand contest. Not only are they (users) shaped by incoming technologies, they are also able to reshape the recipient technologies orsometimes reject them *per se*, leading to 'a persistence of the old' no matter how out of favour, going by the grand narratives of progression, it might be.

Looking at processes of transfer, adaptation and appropriation as translations allow us to follow travelling elements on their journeys between different sites- both in a fine-grained minute fashion or by tracing larger, more encompassing trajectories.[137] The study of technology in Africa, like any other social space, must be de-territorialized and

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[135]Ibid.

[136]Arnold(2005).

[137]Behrends, Park and Rottenburg (2014).

re-territorialized so as to address aspects that give credence to the adaptation, appropriation, mixing, rejection or resistance at local level.[138] In colonial parlance, technology transfer was proposed by the implementers to be adopted as a socio-political or economic instrument for change. For instance, in the latter half of the 19th century, Istanbul witnessed massive changes to its urban infrastructure systems, specifically water supply. The Ottoman reformers believed that modern urban technologies– such as central water supply, sewers, and street cars– would raise the general level of culture, which was defined and redefined as a continual and contested process.[139]

However, the effortby city planners to attain homogeneity through technological reforms misses the point in that individual citizen and officials have modified and sometimes even rejected the changes.[140] Technology in transfer remains susceptible to indigenous adaptations and contestations. As it enters new geographical frontiers, it is reconfigured to achieve user-specific ends. Elisio Macamo and Dieter Neubert propose that we study African local appropriation through the pull factor of attractive 'products of modernity' that cause social change locally.[141] Concepts such as 'glocalisation', 'hybridisation' and 'creolization' as approaches addressing the mixing of various culturally embedded practicesoffer an explanation on the process of appropriation of incoming technology. [142] Butcategorizing them as 'attractive' products of modernitylegitimizes the view that these migrating technologies come as superior to and for the good of the local. What is modern or modernity? In exploring Eisenstadt'sconcept of 'multiple modernities',[143]how does it play into the technology transfer discourse?

All in all, David Edgerton defines 'creole technology' as that which finds a distinctive set of uses outside the time and place where it was first used on a significant scale. Therefore, I argue that technology undergoes a process of enculturalization, where it is prone to alteration, modification or complete adoption for a totally different use that fits

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[138]Ibid.

[139]Dinçkal (2008), pp. 675-700.

[140] Hård and Misa (2008).

[141]Macamo and Neubert (2008); see also Spittler (2003).

[142] Brathwaite, Shepherd and Richards (2002); Robertson(1992).

[143]Eisenstadt (2000), pp. 1-29.

well with the local needs of the users. Users are a source of both active and unintentional innovation. They matter not only because they use technologies in unforeseen innovative ways but also because they themselves develop new and innovative technologies, services, approaches and so on.[144] Basically, ideas do not remain unchangedas they flow but are subject to translation.[145] As diffused ideas are translated throughout theircirculation, and as they evolve differently in different settings, they may not only lead to homogenization but also to variationand stratification. The concept of 'editing' has served to describe and explainhow such translation proceeds – thus further focusing on the dynamics of circulating ideas.[146] The history of technology, while exploring the question of colonialism in Africa in line with technologies that came along and continue to be imported, needs to see them not as prototypes but as templates that are subject to processes of localization.

As they mediate through space and re-establish themselves within society, do technologies operate as neutral entities? Contextualised and post-context historical analysis locates technology as a cultural construct that is embedded with different forms of character within the socioeconomic and political milieu in which it operates and thrives. Technologies can be translated politically and their functionality within society depends on certain political structures or by extension, they may reframe and restructure the balance of power in locales where they apply. There is a need, as espoused by Langdon Winner, to recognize how social and economic forces shape technologies.[147] What matters is not the technology itself but the socio-economic system in which it is embedded.

Moreover, if our moral and political language for evaluating technology includes only categories having to do with tools and uses, if it does not include alteration to meaning of designs and arrangements of our artefacts, then we will be blinded to much that is intellectually and practically crucial. The endeavour is not to look for conscious conspiracies or malicious intentions.[148] The undertaking to understand the environment

[144]Egyedi, Mehos and Vree (2012), pp. 1-16.

[145]Sahlin and Wedlin (2008), pp. 218-242.

[146]Ibid.

[147]Winner(1980).

[148]Ibid.

within which the water and sanitation infrastructure system for Nairobi has systematically developed in its various epochs is to provide more insights that go beyond the blanket notions of the pull and push between the colonizer and colonized, the governors and the governed, and the rich and the poor. Hård notes that technology is applied to groups to preserve or alter social relations, and foster technological change. He states that arising out of conflict, technological change is never a socially neutral process.[149] In this view, the application of technology is not, in the first place, defined as a means of using natural resources or as a tool for alleviation of physical strain. Rather, it is seen as a tool of establishing and influencing social relations.[150]

Despite the consensus around the history of technology in general and how it needs to be approached from a multifaceted perspective, in Africa,it remains relatively an upcoming discipline that is struggling to gain roots. Clapperton Chakanetsa Mavhunga, a Zimbabwean environmental historian, lends his voice to the technological debate for the former colonized societies by advocating for what he calls 'technologies of everyday life'. Mavhunga uses the analogy of 'the horse and rider relationship' [151] in explaining the technological nexus between North and South. The rider enjoys the ride as the horse shoulders the burden and does as directed. This nexus further forecloses a view to ordinary people as creative beings in their own right. Mavhunga's work, by using the example of hunting and the human interaction with the forest as mediated through the world of spirits, brings to the fore the question of STSs capturing people's imagination and seeing science and technology as an aspect of everyday practice.

2.1.4 Duality, Infrastructure Systems, and Urbanity in Africa

The process of urbanizationthe world overis basically marked bytechnological advancements. Those technologies emerge to characterize the body that is the city as they bore artefacts that become the nature, nurtureand body politic for the city. Once fully developed, the technical systems become naturalized as part of the whole, many times going unnoticed unless they fail. They are the connective tissues and circulatory systems of 'modernity', and hence infrastructures.[152] They become the unavoidable

[149]Hård (1993).

[150]Ibid.

[151]See Mavhunga (2014), p.7.

[152] Edwards (2003).

'extensions' of the whole. Those infrastructures are mostly invisible. But by constituting what would be termed as the appendages on which the city revolves, they become the core of that city. They distinguish the urban from the rural' city, from upcountry or reserve (in colonial Africa). As an organic entity and supported by technical systems that are organs[153] in themselves, the city evolves over time, acquiring new form, shape and functionalities. The path of evolution, however, is context specific, determined by geographical factors, political considerations, scientific innovations, and environmental trends, amongst other factors.

Bill Freund asserts that while particular towns and cities that fit particular historical purposes and political or economic ends may come and go, the urban tradition is one of accretion and agglomeration, not one of entirely distinct stages. Cities inevitably carry baggage from their individual and collective pasts that have to be understood.[154] Part of the baggage that urban Africa carries is the imprint of decades of European imperialism and colonialism. However, Fourchard warns that an overemphasis on the perspective of the colonizers rather than the colonized has led to inconclusive typologies common to many syntheses of Africa's urban past, which 'tend to divide between the essentially African and the essential colonial city'.[155] Moreover, seeing Africa's cities only in terms of their colonial and post-colonial relationships may preclude a fuller understanding of the multifaceted ways in which they have engaged with the larger world.[156]

Despite the risk involved in taking these binaries towards understanding urbanization in Africa from the age of colonialism, the city in Africa has continued to present a picture of 'two worlds' not only spatially but also socially. What is revealed is the case of continuities and discontinuities during colonialism and into the post-colony. The European colonial occupation of Africa marked the destruction of old cities and their replacement with a benign neglect of the old and the establishment of adjacent new frontiers, ahybridization, whereby the old mixed with the new and in certain cases, new areas were established that grew into important cities. The persistence of the 'old' was

[153] Hughes (1983).

[154] Freund (2007).

[155] Fourchard, (2011).

[156] See Abdulmaliq(2001).

partly as a result of resistance from the indigenes, who fought for preservation or, where aspects of indirect rule were instituted, the non-interference policy witnessed aspects of the old thrive to inform the character of certain cities, for instance, in northern Nigeria.

In terms of appropriation of space, the colonial era has been marked by exclusion exhibited through racial segregation in terms of access to space and subsequent infrastructure systems. However, as envisioned by this study, this narrative needs to be interrogated further beyond its normative depictions. What is depicted is a vivid picture of 'dual cities' in Africa, although these aspects of duality in terms of access to urban infrastructure are not unique to Africa, as revealed by the history of industrial Europe.[157] All in all, cities in the South remain divided, where the former 'European town' is currently occupied by the petty bourgeoisie, which took over the reins of power from the colonialists. It is characterized as modern, spacious, low density, well maintained through town planning and culturally different from the surrounding environment. The second, which houses the mass of the city that is basically poor, is usually separated from the first by parks, railway lines, open spaces, andis invariably more densely settled with traditional housing and is overcrowded and lacking in services and infrastructure provision.[158]

Contemporary cities in the former colonies are trapped in their past. They exhibit thick layers of colonial imprints despite the indigenes' resilience and resistancebeing visible sometimes. The important point that King makes is the observation that past studies have taken a Western frame of reference; hence, they end up under-representing or misrepresenting the realities of the Global South. The agency of the accounts from locals is very critical of contemporary scholarship for this will shed more light on the character of the city and develop inclusive works of knowledge.

William Cunningham Bissellobserves that colonialism was marked by contradiction, confusion and even chaos.[159] Within these environments of suspicion and prestige, it is

[157]See Hoblyk and Suprun (2016), pp. 1-6; see also Sharma (2013), pp. 1-9.

[158]King(2009).

[159] Bissell (2011).

imperative for technologies of provision in the form of infrastructures to be unbundled and unpackaged to reveal their embedded nuances of conquest, resistance, submissionand rejection. As laboratories or experimental terrains for the metropole to try out technologies of the modern, as Wright[160] and Rabinow[161] put it, how do these inform the social and political techno-spaces in the Global South, especially for emergent cities like Nairobi?

Exploring the question of what he refers to as 'exceptionalism' in an article titled, '*Why African cities matter'*, Myers delves deeper into the methodological debate that tends to sectionalize cities of the world through bifurcation. As a result, the Global South cities have been marginalized. The pompous characterization of some cities into 'global cities' against 'slum cities' amongst other juxtapositions creates a smoke screen that masks the potential of Global South urban locales. Myer's proposes that the focus should be more on the historicity and particularities of cities rather than on exceptionalism.[162] While cities in the world today are major points in a meshed-up web of the global economy, each one of them has its unique history and a different social fabric that sets it apart to a degree that demands its own particular approach in a way that unbundles it successfully, leading to inclusive narratives of technological invention, innovation and appropriation, especially in urban provisioning. Furthermore, rather than seeing cities for how they fail in terms of infrastructure and economy, we need to approach them for the multiple relations and practices that constitute how they work.[163]

With the view that infrastructures as technological artefacts are non-neutral, Antinna von Schnitzler explores the question of techno-politics surrounding water and energy infrastructures in South Africa.[164] She reinforces the idea that artefactsundergo a process of interpretation or perhaps translation that enhances contestation or rejections, emanating from the prevailing political push and shove. The controversy that surrounded the introduction of Pre-paid Meters (PPMs) in South Africa's low-end areas

[160] Wright (1991).

[161] Rabinow (1989), pp. 32-46.

[162] Myers (2011), pp. 101-106.

[163] Mclees (2013).

[164] von Schnitzler (2008), pp. 899-917.

brings forth the high politics of technologies or infrastructures and how different social classes conceive and visualize new technologies that are applied from above. While PPMs can be rationalized as a viable innovation aimed at controlling consumption and regularizing supply of services within the dictates of the laws of demand and supply, the South African protests, as vividly elaborated by von Schnitzler, calls for the need to reimagine and re-think the user.

Egyedi, Mehos and Vree refer to systems that are derived away from the central networks as 'inverse infrastructures'.[165] For them, cities, not only in the South but also in the North, are witnessing the emergence of unprecedented infrastructures that are not owned by government or large businesses away from the centralized or controlled top-down by government or industry as telecommunication, energy networks and railways; rather, they are owned and developed by individual citizens or small businesses. Yet they manage to mushroom into local, regionaland even global infrastructures. For purposes of our study, Egyedi, Mehosand Vree's idea of 'inverse infrastructure' informs what we refer to as bottom-linked systems or 'small infrastructures'. Against that back drop and acknowledging that Nairobi's cityscape is littered with several off-grid spatial zones, I undertook to address it for the inadequacies located within the central systems of water and sanitation, and move a notch higher to locate the decentralized or non-conventional processes of accessing these critical services, that is, the small technologies of provisioning the services.

Jochen Monstadt acknowledges that infrastructures mediate resource flows and vitally shape environmental practices and socio-technical innovation in cities. He further asserts that adequate conceptual approaches, which reflect the complex interdependencies between cities, networked infrastructuresand urban ecologies, and which broaden our understanding of ways we can develop, govern and renew our infrastructures in cities in a sustainable way, are needed. The inter-relationship between infrastructure and ecology vividly comes out.[166] For him, cities are pivotal sites in which resource flows 'metabolized' by infrastructures are geographically concentrated, and the everyday exchanges between networked infrastructures and

[165]Egyedi, Mehos and Vree (2012).

[166]Monstadt(2009), pp. 1924-1942.

natural environments occur. However, although not within the scope of this study, the relationship between urban and its peripheral ecology is more of a parasitic nature than symbiotic.

Drawing attention to the infrastructures that characterize the day-to-day experiences of the city and its residents, it has been argued that socio-technical innovations in water supply, sanitation, energy supplyand transport, amongst other services, are at the core of evolving urbanization processes and have permitted the extreme acceleration of the urban metabolism.[167] The equilibrium between nature and societies sustainability results from how we develop, governand renew our urban infrastructures. Moreover, the quality of networked infrastructures and the degree of social and geographical access to them has a huge impact on distributional justice and social wellbeing in cities, as explained by the proponents of the 'splintering urbanism' school of thought.[168]

Although overly high modernist in approach, Neuman and Smith assert that great cities are born and give rise to great infrastructures.[169] The development of infrastructure transforms urban spaces and gives a city an image and infrastructure thatin itself possesses transformative power. It revolutionizes the city. Perhaps a city is ranked on its level of infrastructural development and a functional infrastructure network sustains the city. Infrastructures lessen equity disparities, providing sustainable solutions and hence lowering non-renewable resource depletion and environmental impacts at all scales.

The 'modernization' of water and sanitation provision system in urban environments, including Nairobi, was basically to deal with the question of miasmas. As such, one would have expected an attempt at instituting a web of supply infrastructures on a universal basis for the nascent city. However, only 'Europeanized zones' were serviced by the networked system. While racial segregation policy, believed to have been pursued by the colonizers, promises to provide answers to the inadequacies in infrastructure development in cities in the Global South, for example, Nairobi,

[167]Harvey (1998), p.45 .

[168]Graham and Marvin (2001).

[169] Neuman and Smith (2010), pp. 21-42.

exploring the question of whetherthe outcomes of the systems were premeditated is more promising. Is inequality a structural component embedded in the artefacts that make up LTS?

In a study on 'water vending' in Tanzania, Marianne Kjellén paints the differential picture of most cities in the Global South as she states that in most developing countries, a piped water supply in the cities is the norm for the richer households, while poorer households struggle with a number of alternative means for accessing water.[170] With the majority of the urban poor in these cities sitting on what are characterized as 'illegal' spaces (slums, informal and squatter areas), city authorities decline to provide and plan for service provision (water included) grounded in the argument that incorporating these informal areas in the city planning structures in themselves would be institutionalizing illegality.[171] Hence, despite these areas absorbing more than half of a city's residents, they continue to operate like blank spaces on city authority master plans and policy papers. Diminishing state resources coupled with inadequate urban management capacity and the insufficiency of conventional approaches have rendered it impossible to provide basic infrastructure in urban areas in developing countries such as in the city of Dares Salaam.[172] Faced with these realities, how do the urban residents reproduce themselves from below for sustenance?

Perhaps the biggest tragedy for the cities in the Global South is that some of the non-conventional approaches, on which,according to a conservative figure, close to 70% of the people in these cities rely to provide themselves with services, are easily labelled illegal and as a result it reverses the efforts towards the development of stable cities. Scholars, like administrators, remain culpable for promoting the so-called dominant ideals and planning models through their discourses and publications.

[170]Kjellén (2010).

[171] Akallah(2012) (unpublished MA thesis).

[172]Kyessi (2005).

CHAPTER THREE

THE 'GREAT STINK' OF NAIROBI: SANITATION, WATER AND THE POLITICS OF SITE LOCATION, 1899 TO 1919

3.1 Introduction

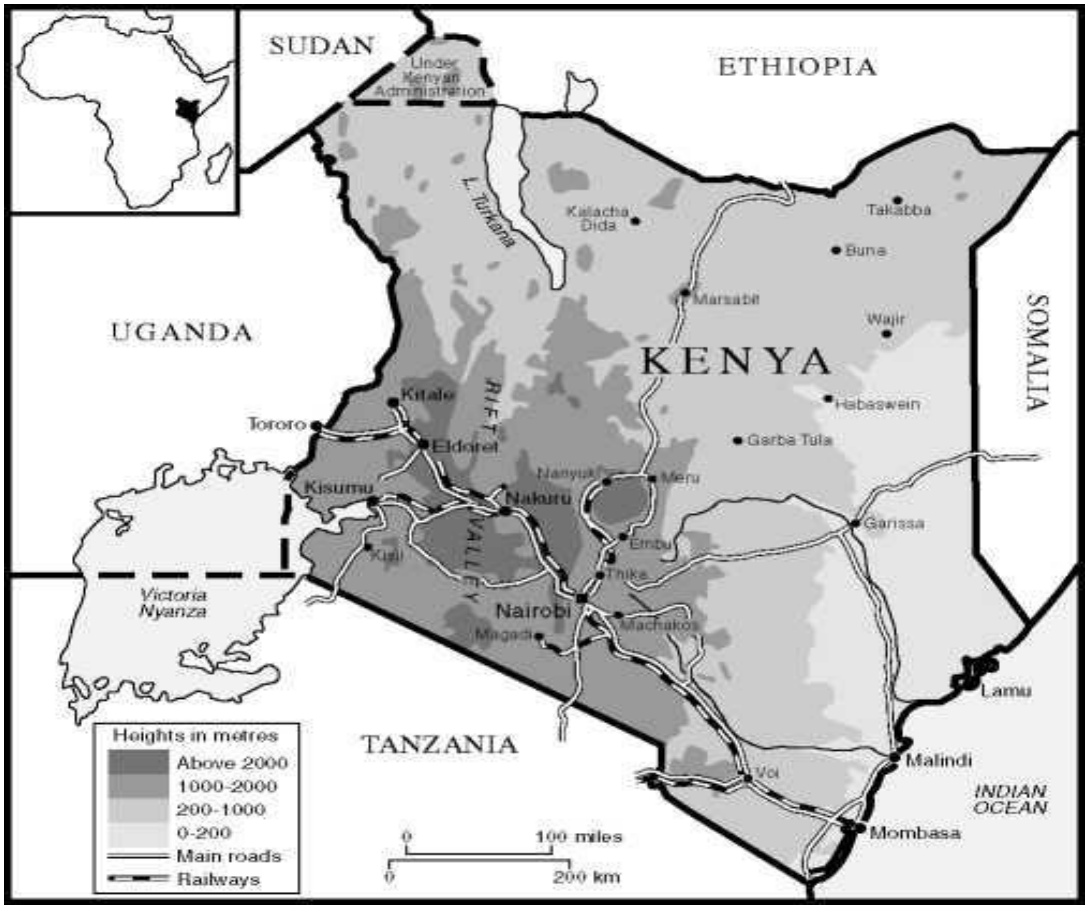
It is not easy to delineate the development of water and sanitation provision systems for Nairobi in isolation from the other cities across the continent of Africa, especially those in former British colonies. The histories of water and sanitation infrastructure development for Accra, Lagosand Kampala resonate almost script for script with that of Nairobi. This was even more the case during the pioneer years of the British colonial establishment. Despite the geo-political differences across Africa, at the beginning of the 20th century, the same questions arose regarding the spatial suitability and appropriateness of the water and sanitation technologies to be adopted for the future of the rising administrative and commercial capitals. The filth in Lagos, compounded by the poor drainage system, and the plague outbreaks of the 1900s in Accra led to broad discussions on the need to rethink the water and sanitation question.[173] Nairobi, which was an infant rail outpost, and the politically redefined Kampala were similarly not spared from the vital question of 'modernised' access to water and sanitation. However, with the differences in geographical bearings, each of these cities has had its unique development path in water and sanitation. The specific challenges of each city in relation to ecological and economic factorsand the coloniser's motives cannot be downplayed. To that end, this study purposes to broaden the scope of understanding the technological developments in the inception and attempted augmentation of the water supply and sanitation system for Nairobi during the first two decades of the 20th century.

First and foremost, this section expounds on the centrality of the role of railway authorities in the emergence of Nairobi as a city and in the pioneering waterworks of its officials. Secondly, the successive recurrence of plague outbreaks and the broad discussion on relocation of the Nairobi site are put into context to explain the underlying politics engineered by various parties with competing interests. Thirdly, the re-emergence of plague outbreaks, which led to the establishment of another sanitary

[173]Brown (1992), pp. 337-360.

commission in 1913 and the laying of the first major drainage/sanitary system for Nairobi, is discussed with the aim of clearing the greatest 'public health scare', reminiscent of 'the great stink of London' in the mid-19th century, that is, the Indian bazaar. Lastly, a conclusion is drawn derived from the foregoing discussions. This aims at painting a vivid picture of how Nairobi as a colonial capital 'proper' thrived as far as augmenting its water supply and challenging the sanitary menace were concerned.

Image 1:Map of Kenya



Source: http://www.worldhistory.biz/sundries/29395-kenya-nineteenth-century-precolonial.html

3.2 The Birth of Nairobi City

At the advent of European colonisation in Africa, Nairobi was an expansive area that served as grazing land. The pastoral Maasai ethnic group grazed it intensively with their stock of cattle. The long droughts coupled with famine in the last quarter of the 19th century had seen the Maasai venture into the plains in search of water and pastures for their diminishing stocks. Certainly, the Nairobi River provided a viable attraction to

the area, which the Maasai referred to as *Ewaso Nyrobi*, meaning 'a place of cool waters'. For the Kikuyu, the cool climate and fertile lands to the Northwere an assurance of food production in the wake of major droughts and famine. Temple claims that both these indigenous peoples were trying to establish hegemony over the area during the last half of the 19th century prior to the advent of the railway.[174] While Nairobi was not a major outpost for the popular long-distance caravan trade that thrived across the entire East African region from the coast as far as Central Africa, its unique topographical features were instrumental in influencing its growth as a rail outpost. This is clearly summarised by one of the administrators, Sir Guildford Molesworth:

> Nyrobi has, with great judgment, been selected as the site for the principal workshops. It is about 5,500 feet above the level of the sea, which ensures a comparatively salubrious climate; there is ample space, of level ground for all sorts of requirements, and excellent sites, for the quarters of officers and subordinates. On higher ground above the station site, there is a fairly good supply of water but reservoirs and tanks will have to be constructed.[175]

According to White, Silberman and Anderson, it was not long after the coming of the railway in 1899 that two facts became clear. First, it was going to be impossible for the railway authorities themselves to cope unaided with the social consequences of the development they had initiated at Nairobi. And secondly, as the government took over these responsibilities, it was necessary to 'associate at least the expatriate social control and social provision which were needed.'[176] How the railway authorities decided to establish a major outpost at the site that became Nairobi, despite the glaring challenges of drainage, remains unfathomable. It was clear that the black cotton soils in most of the area were poor at draining run-off water. Perhaps the expansive Rift Valley terrain that stretched away a few miles from Nairobi prompted the railway engineers to

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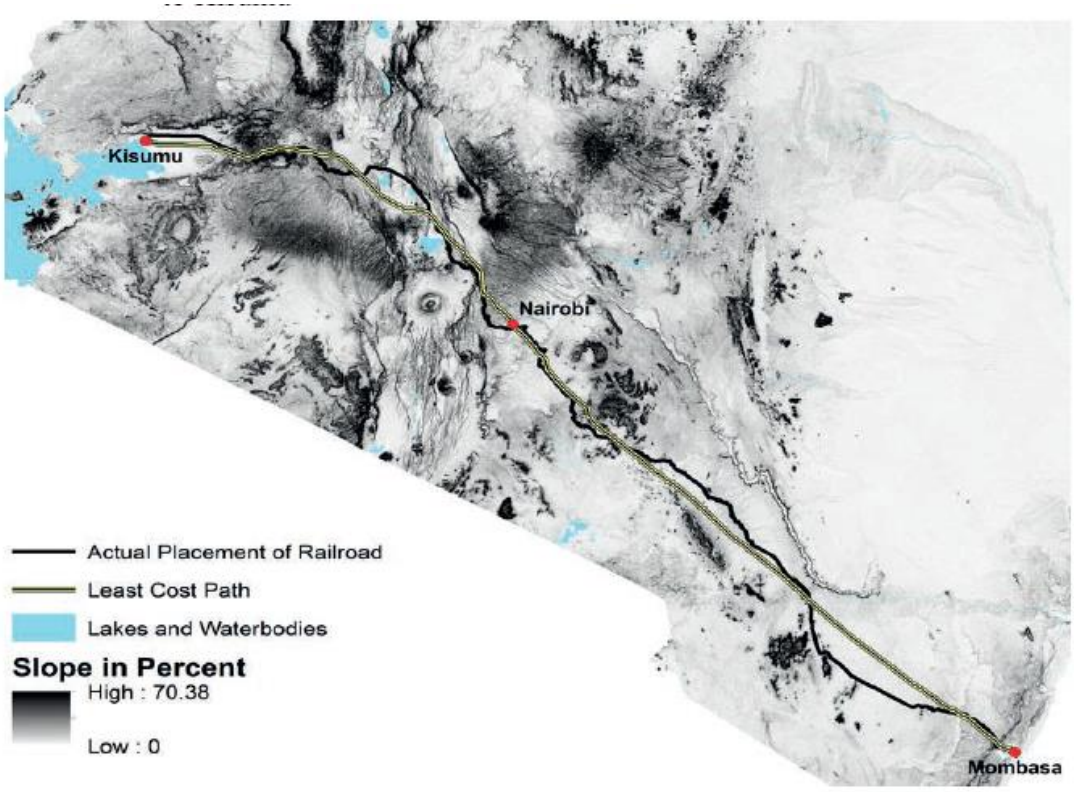
[174] Temple (1973).

[175] Quoted from Hake (1977), p. 9.

[176] White, Silberman and Anderson(1948).

consider strategic reasons for the Nairobi site in terms of co-ordinating their activities and materials. Nairobi was centrally positioned between the Kilindini railway headquarters in Mombasa and the dense Kenyan interior. In the years that followed, the decision to turn a blind eye to Nairobi's problems as a site would haunt the city in a major way in terms of health.

Image 2: The railroad stretch from Mombasa to Kisumu



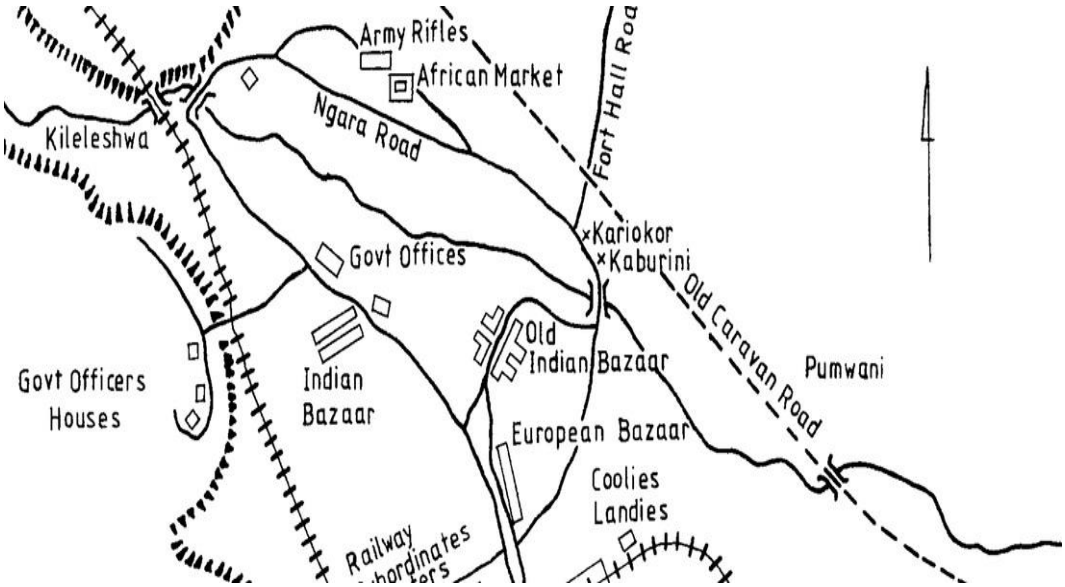
Source: Jedwab et al (2016).

The construction of the Uganda Railway (later known as the Kenya-Uganda Railway) was aimed specifically to open up Uganda, which the British had secured for its importance as the source of the River Nile on Lake Victoria. This has made many historians o believe that Kenya's colonisation was by default rather than design. All in all, it was the construction of this railway line that had a domino effect on the East African Protectorate (Kenya Colony), socio-economically and politically. The railway engineers were the first to conceive Nairobi's planned infrastructures, especially water, as they needed it, both for locomotives (steam engines) and for their domestic purposes. In 1907, Nairobi officially became the capital of the East African Protectorate due its strategic importance in being located in between the Kilindini Harbour and Port Florence (Kisumu).

To be able to institute a semblance of governance alongside the railway administration, a decision was made by the colonial government to shift its administrative post from Machakos. The Sub-Commissioner of Ukamba, John Ainsworth (1864-1946), assumed authority over Nairobi. Nairobi, thus, witnessed two centres of power and influence. This form of 'duality' has been blamed for the ad hoc nature with which Nairobi

developed. During the construction of the railway line, as noted by F. H. Goldsmith, the railway administration was entirely separate from the government of the Protectorate, an *imperium in imperio,* having its own police andmagistrate and controlling all land for one mile either side of the line.[177]

Image 3: An outlay of Nairobi at its inception showing various facilities



Source: http://healthycities.berkeley.edu/history.html

When Ainsworth arrived, representing a parallel authority to that of the railway, he was not greeted with much enthusiasm by the authorities. On arrival, he immediately engaged the then Chief Engineer, George Whitehouse to inquire about what land was available and separate from railway holdings. Whitehouse indicated that all of the land on the north bank of the Nairobi River, as well as portions on the south bank and the higher grounds, towards where the European hospital would later be built, were available for the government to take. A few months after Ainsworth's arrival, the government's presence at Nairobi was beginning to take shape in the form of completed offices. These included the sub-commissioner's office, the magistrate's court, the Accounts Office, Registration, and the Lands Office, the Assistant Collector's Office, a police post and lines, and a temporary jail.[178] However, despite all these works by the colonial authority, the railway presence remained remarkable.

[177] Goldsmith (1955), p.52.

[178] Maxon (1980), p.98.

An easily noticeable feature of early Nairobi was the disparity in the physical appearance of government installations as contrasted with those of the Uganda railway administration.[179] The disparity in terms of quality of housing and amenities for the nascent city between railway and government establishments resulted from the fact that as a company, the railway corporation wielded much stronger economic power than the protectorate government,which also suffered from being understaffed.

Goldsmith, writing John Ainsworth's memoirs, details the new developments in terms of infrastructure that altered the landscape of Nairobi prior to the coming of the railway line. By the end of 1899, the railway administration had laid out a roadway, which was named Victoria Street, leading from the west side of the station to the Nairobi River, where a bridge was built.[180] Land acquisition in Nairobi and its environs was through auction, and a plot in Nairobi was acquired at an average price of between Rs. 500 and Rs. 200.[181] Nairobi was fast changing shape from the tented settlement at the end of the 19th century to a booming commercial and administrative centre. On the plot nearest the railway station, a general store and hotel that later came to be known as 'Wood' was erected. Messrs. A. M. Jevanjee and Co. built a soda water factory and living quarters for a manager. Messrs Boustead and Co., Ridley and Co., George Stewart and Co., Mr. Huebner (a German trader associated with Hansing and Co.) and one or two others put up stores and living quarters. [182] On one plot, a post office was erected near the station. Another road running parallel with Victoria Street was marked out from the station entrance. This road came to be known as Government Road (currently Moi Avenue). It took a turn to the right about 400 yards from the station and ran into the continuation of Victoria Street near the bridge. From the turn up to near the bridge, a space was left for an Indian bazaar,[183] with the number of Indian traders averaging about 150 by 1899. [184] Ainsworth, as the overall administrator of Ukamba Province and the representative of the British Crown, undertook to make the road that ran along Government Road to the point where the Nairobi River was crossed by 'Ainsworth

[179]Ibid.

[180] Goldsmith (1955), p. 53.

[181]Ibid.

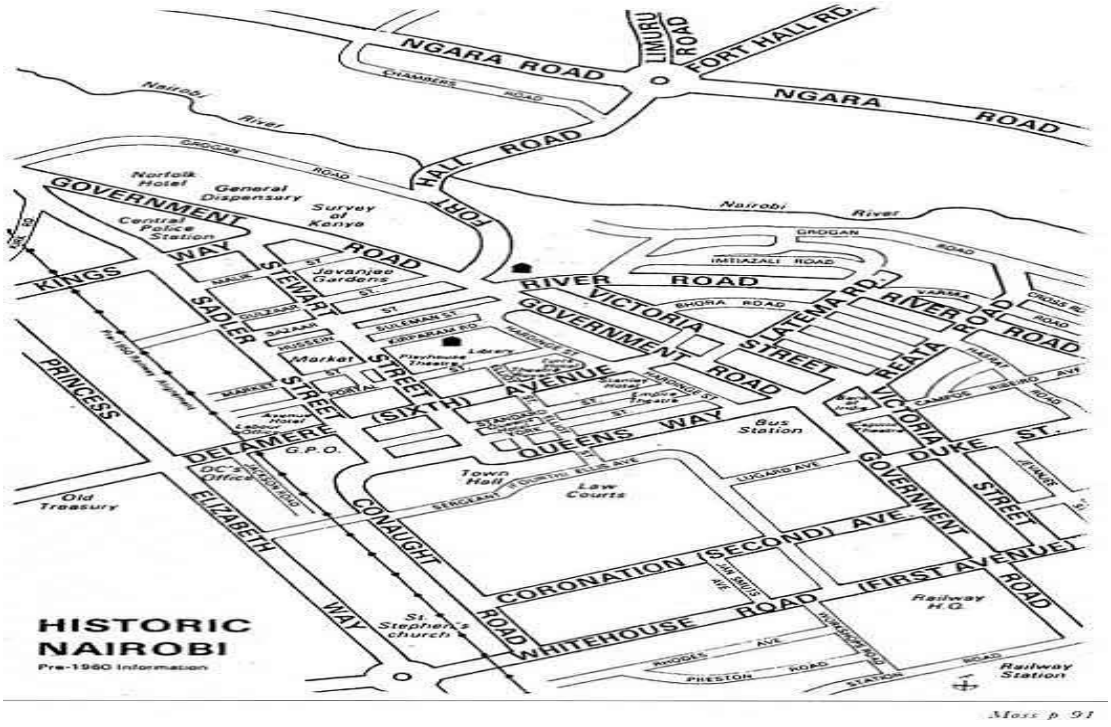
[182]Ibid.

[183]Ibid.

[184] Maxon (1980), pp. 99-100.

Bridge' (named after him and later washed away by a major downpour that necessitated it being rebuilt). This road, later to be known as Ngara Road, was carried along the top of the north bank of the river to connect with what is now known as Kiambu Road. At a short distance from the top of 'Ainsworth Hill', where Ainsworth put up his bungalow (currently known as Museum Hill), a branch road was made into what in now Parklands and from there to Sclater Road.[185] However, these road works were not easy going. On Ainsworth's own admission, the black cotton soil on the Nairobi plain was devoid of any possibility of drainage except at huge cost out of all proportion to the importance of the place.[186] The National Bank of India, which had been established in Mombasa for some years, opened a branch in Nairobi in 1900 and the Sub-Commissioner arranged for a small wood and iron building as temporary accommodation for them.[187]

Image 4: Old Nairobi streets



Source: http://www.sikh-heritage.co.uk/heritage/sikhhert%20EAfrica/nostalgic%20EA/nairobi-streets.jpg

This map shows the main streets typical of a colonial city as shown by the imprints on the street names. After independence in 1963, most of the street names changed, taking on an indigenous orientation and heritage.

[185] Goldsmith (1955), p. 53.

[186] Maxon (1980,)p. 99.

[187] Goldsmith (1955),p. 54.

These pioneer works paint a picture of Nairobi as it took shape, developing from scratch along imported ideals that were spearheaded by the Uganda Railway through its engineers and employees, mostly from India (referred to as coolies or landhies) and, on the other hand, a parallel authority representing the Crown, headed by Sub-Commissioner Ainsworth. One outstanding feature is how haphazard the city was developing based on the emerging needs of the European, Indian and 'native' populations coalescing around the opportunities and demands available. Nairobi as a new township was developing in a piecemeal and uncoordinated fashion, with no overall plan for construction.[188] 'Our trouble,' Ainsworth wrote after his retirement, 'was due to the fact that we had no definite scheme or layout approved; consequently, things just moved on and were liable to alteration to suit some particular fad and fancy'.[189]

The railway authorities adopted their own plans and exerted greater autonomy on how they managed the land that had been earmarked as being within their control. This duality of authority seems to have been the greatest factor that determined how the new township shaped up, especially in the period to 1920, when the Crown assumed much control in the former East Africa Protectorate. As earlier noted, the railway officials had reluctantly embraced the arrival of the colonial administration in Nairobi. The government's weak financial position vis-à-vis the Uganda Railway compromised the governance aspects in terms of town planning, especially at the decision-making level. Without strong laws and policies to assert control over the emerging capital, the sub-commissioner of Ukambani played second fiddle to the railway administration in Nairobi. Infrastructure development and adjudication experienced a state of inertia and uncoordinated practices that saw the city continue to expand without the requisite planning.

The establishment of Nairobi as the headquarters of the Ukamba Province and the recognition of its emerging role in the administration of the protectorate saw the establishment of the Township Committee, which was founded along the municipal principles of governance found in Britain. It was constituted in April 1900, and headed

[188]Ibid.

[189]Ainsworth memoirs in Maxon(1980), p. 100 and Goldsmith(1955), p. 52.

by Col. John Ainsworth, assisted by five other officials chosen by him. From their first meeting of December 1900, the committee realized that they had no powers to implement their resolutions. They had no power to impose by-laws and rates. Public health, coming on the wake of the smallpox outbreak in Ukamba that had seen Ainsworth, for lack of personnel, personally administer vaccination amongst the population in Nairobi, was the committee's key mandate, yet it had no power to impose any by-laws towards this end. Consequently, it was found necessary, especially with the arrival in 1901 of Sir Charles Eliot as the commissioner for Nairobi, to repeal the 'Nairobi Municipal Regulations 1900' so as to vest more power in the committee.

The new regulations of 1901 gave the commissioner power to annually nominate during the month of April one protectorate official, two railway officials, whose names would be furnished to him by the chief engineer for that purpose, and three of the leading merchants or other residents in the township of Nairobi (not being railway or protectorate officials) to act with him as a committee for the purposes of the regulations.[190] In clear terms, the mandate of the Sub-Commissioner and his committee was to institute or charge rates after assessing all lands and buildings in an area comprised of an areawithin a radius of 1½ miles from the then office of the Sub-Commissioner in Ukamba at Nairobi. Their services were defined strictly as policing, cleansing and lighting the township of Nairobi, and in defraying the necessary expenses of the committee.[191]

The repeal of the 1900 municipal regulations was important in that it managed to centralize authority in the Sub-Commissioner's office and, to a greater degree, diminished the institutional duality of power that had derailed the process of managing the infant city. However, with the Railway Corporation managing the water infrastructure in the city, coupled with a strong financial base and autonomy, it continued to wield immense power. To underscore the centrality of the Uganda Railway in the making of Nairobi, Robert Foran quipped: 'while Col. Ainsworth was the "'foster-parent" of Nairobi, the Uganda Railway was widely accepted as the "real father"'. Nevertheless, the ad hoc nature by which Nairobi existed was a major

[190] British National Archives, Kew, Nairobi Municipal Council, File Ref No: FO.881/7685

[191] Ibid.

impediment to infrastructure planning, especially one based on land concessions.[192]

Armed with the powers resulting from the new Nairobi Municipal Regulations, 1901, which were published under *Gazette notice Number 20*, the committee issued a two-month ultimatum for improvement of buildings. This was specifically aimed at raising the sanitary standards in the township and public health in general.However, before the notice expired, a disaster in the form of bubonic plague[193] (to be dealt with at length in a later part of this section) hit the township. Also in 1902, a fire broke out, starting in Wood's Hotel in Victoria Street, and all the buildings except two were razed to the ground, including the post office, apart from its contents, which were salvaged.[194]

3.3 The Kenya Uganda Railways and Harbours Corporation: (Mis)Planning a Colonial City a nd a Water Supply

According to Hugh Hume Dixon, who was a partner at Howard Humphreys and Sons (Consulting Engineers, London), the selection of Nairobi as a railway depot was based chiefly on the presence of the Nairobi River, and the earliest water supply was drawn from that source.[195] In the early days, a medical officer reported that during the rainy seasons, this water was 'simply the colour of pea soup and undrinkable at the standpipes'. [196] In the eyes of the incoming European railway staff and colonial administrators, an engineering solution had to be found to make the Nairobi water 'drinkable'. Though sanitation to a great extent continued to be provided on location through pit-latrines and the bucket system, the task of watering the nascent city of Nairobi fell squarely on the railway engineers.

Though the siting of Nairobi as a railway depot had everything to do with the expansive flat plain, as earlier observed by Hugh Hume Dixon, water supply was central to its growth. The railway corporation assumed the primary role of establishing the

[192] See Murunga (2013).

[193] Maxon (1980), p. 109.

[194] Goldsmith (1955),p. 54.

[195]Dixon n.d.

[196]Ibid,

pioneering works.[197] The railway needed water not only for its staffs but also for the locomotives, all of which were steam powered. The earliest water supply for the railway encampment was taken from a small concrete dam within the Chiromo Estate and was piped by gravitational pull towards the railway land in 1899.[198] Water engineers saw the gravitation scheme at the time, beginning in 1840 in Britain with successful projectshad transformed Manchester, Bradford and Glasgow, amongst others, as constituting the sole approach to the question of a healthy, sanitary city.[199]

In the eyes of the proponents of the gravitational scheme, it was the best technology for keeping cities flush with water for drinking and bearing away human and industrial waste, and because it was presumed to be the best method for introducing water to all homes in all corners of the city, they expected it to revolutionize the sanitary status of cities.[200] The advocates of the gravitational school of water supply by extension did not limit its application in Britain alone. Instead, as John Broich clearly states, they exported their specialty to cities like Bombay, Hong Kong, Colombo and Singapore.[201] However, their implantation without tinkering or respect for the local realities in the process of transfer has been faulted for their failure or for the devastating social effects they had across the former colonies.

Away from the 'correctness of technology' as applied between the metropole and the colonies, the use of Indian coolies as technicians in pioneering Nairobi's 'modern' infrastructure technology is worth noting. Not only were most British engineers working in the colonies bringing on board vast experience from India, but also India was being relied upon as a model of how best to approach the new colonial frontiers on the African continent. Indian cities like Mumbai became prototypes if not templates for major construction works in African colonies.[202] In the same respect, Broich points out that social and environmental conditions in the metropole were not similar to those in the colonies, but the engineers who undertook the gravitation scheme showed a failure

[197]Blomkvist and Nilsson (2017), pp. 283-302.

[198] Smart (1950)accessed at the Kenya National Archives. File No. CUP: 307 .76SMA. 1950.

[199]Broich (2007), pp. 346-365.

[200]Ibid.

[201]Broich (2007), p. 346.

[202]See Sahlin and Wedlin (2008), pp.218-242 for an analysis of the idea of translation.

to appreciate these differences. They approached the task of lifting the gravitation scheme from the landscape of Britain and superimposing it on the empire with great confidence and largely unmodified designs and procedures.[203] How did this unfurl in Nairobi to present different topologies of water and sanitation access?

As Nairobi gradually grew from an estimate size of 3.84 sq. km and an average population of 8,000 in 1900, the small dam at Chiromo was proving insufficient. Furthermore, it was witnessing heavy pollution as it relied on the river as its source. As a result, the assistant engineer for the railway, William Ross McGregor, commenced a major water supply plant at Kikuyu Springs. Assisted by staff who were mostly of Indian descent, he set up a treatment plant on the site at Kikuyu and laid a pipe network to the city that was complete with reservoir tanks and pumps. This was completed in 1906[204] and became, and has remained to date,the main source of water for the nascent city of Nairobi. The Chiromo dam was subsequently abandoned.

3.4 Bubonic Plague and the Politics of Relocation: 1902 to 1907

It goes without saying that the centremost consideration in the choice of Nairobi as a site for the railway depot was plain ground. But this consideration came to haunt the place only after three years, as it was occasioned by plague outbreaks. In terms of suitability, both at a sanitary level and for a sufficient water supply, many experts, especially administrators and health officials,had a poor regard for the site. However, it is interesting to note that the engineers from the Railway Corporation kept faith in the site for reasons best known to them. Perhaps, they understood that the problems facing the infant city possessed engineering solutions rather than being of a geographic concern. Mid-19th century sanitarians had a strong belief in the elimination of miasmas in the urban spaces through moving waters, either as clean water for domestic and industrial use or as wastewater. [205]

While Nairobi had some semblance of a water supply provided for through the railway works, it was the overwhelming population and poor housing facilities non-serviced

[203]Ibid p.348.

[204]Williams (1907). Report on the Sanitation of Nairobi and Report on the Townships of Naivasha, Nakuru, and Kisumu. Kenya National Archives, GP, 363.7.BRI. 1907.

[205]Melosi (2008).

with sanitary systems and reminiscent of the of pre 1850s Manchester and London that seemed to be the tipping point as far as its development was concerned. By 1900, the population of Nairobi was approaching 8,000[206]men and women, who were trudging into the township for varied reasons. Conditions, especially in the Indian bazaar, wherethe majority of the people lived, were miserable and filthy in the extreme, presenting a real threat to the dwellers. This was according to the Sanitary Superintendent who was in charge of public health-related matters.

Apart from the fire disaster of 1902 that burnt down most of the buildings that originally represented the first signs of Nairobi as an emerging commercial and administrative centre, there was a major outbreak of bubonic plague in March of the same year. The plague was first reported in the Indian bazaar, which was a sanitary menace. Ainsworth had personally expressed his misgivings on the choice of site for the bazaar from a public health point of view. 'I have all along disapproved of the present site selected for Nairobi,' he wrote in his memoirs in 1902, 'unfortunately at the time of its selection, the Railway interests were predominant and what the Railway wanted was a large flat space and this they found here…' [207] This was a strong indictment that resulted in the Indian bazaar being evacuated and pulled down. An alternative location was established on what is currently known as the River Road.

The outbreak of bubonic plague forced the medical authorities and the Sub-Commissioner to ponder over the question of the future of Nairobi based on its location at the time. After the successful quelling of the plague, the Commissioner, Sir Charles Eliot, proposed dealing with the situation by moving the town from the plain to the hills. Thus, as Robert Maxon notes, in May 1902, a board was convened to consider changing the site of Nairobi.[208] The board was chaired by the sub-commissioner and was comprised of officials from the government, the railway, the military and medical officers.

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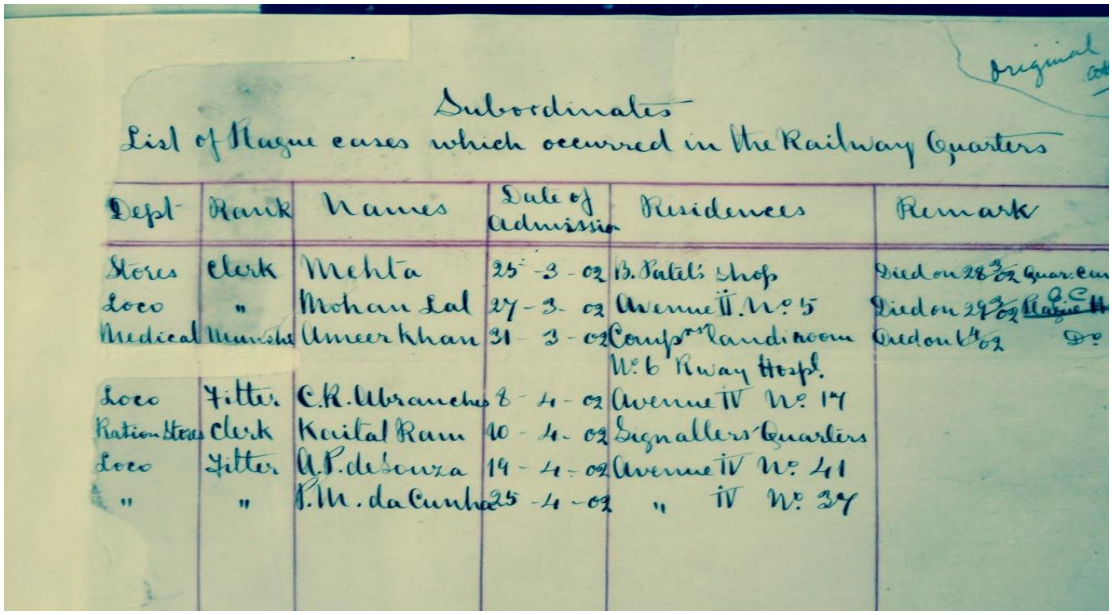
[206]Hake (1977).

[207] Maxon (1980), p.100.

[208]Ibid.

Images 7:List of people diagnosed and treated for plague in 1902

(i) Cases at the Railway Quarters



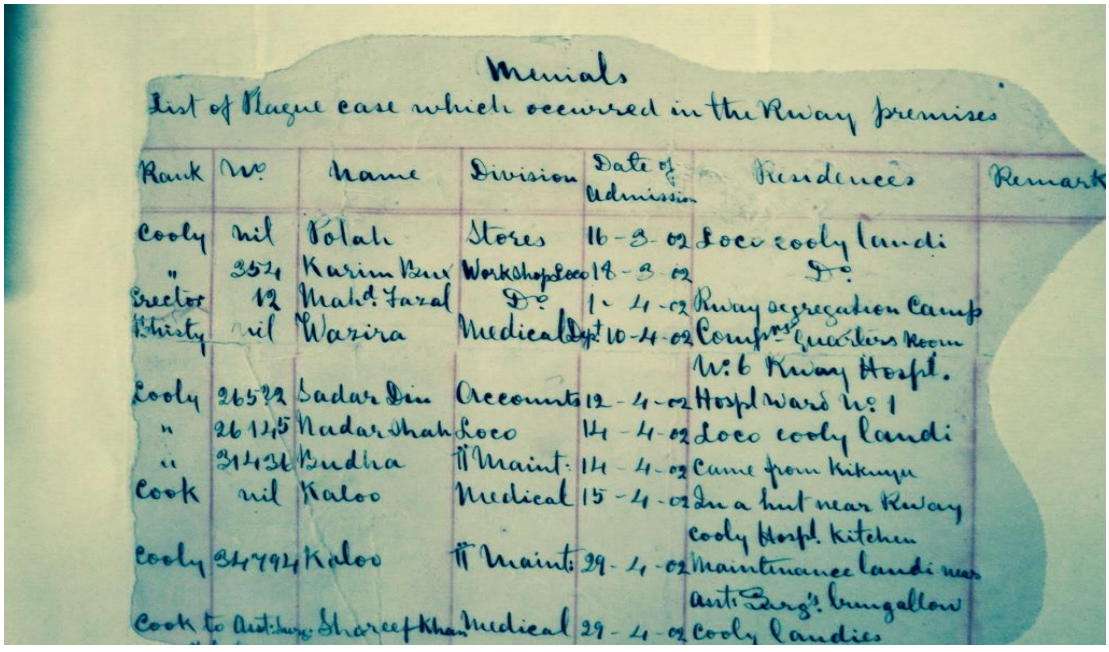
Subordinates

List of Plague cases which occurred in the Railway Quarters

Dept	Rank	Names	Date of admission	Residences	Remark
Stores	Clerk	Mehta	25-3-02	B. Patel's Shop	Died on 28/3/02 Quarantine
Loco	"	Mohan Lal	27-3-02	Avenue II. No: 5	Died on 29/3/02 Plague H
Medical	Menials	Umeer Khan	31-3-02	Compds Landi room No: 6 Rway Hospl.	Died on 1/4/02 Do
Loco	Fitter	C.R. Ubranchee	8-4-02	Avenue IV No: 14	
Ration Stores	Clerk	Kanital Ram	10-4-02	Signallers Quarters	
Loco	Fitter	A.P. de Souza	14-4-02	Avenue IV No: 41	
"	"	P.M. da Cunha	25-4-02	" IV No: 24	

Source: British National Archives, Kew: Ref. No.: MPG 1/1000/2(edited and improved by this author)

(ii) Cases at the Railway Premises



Menials

List of Plague case which occurred in the Rway premises

Rank	No	Name	Division	Date of admission	Residences	Remark
Cooly	nil	Polah	Stores	16-3-02	Loco cooly landi	
"	3521	Karim Bux	Work Shop Loco	18-3-02	Do	
Erector	12	Mahd. Fazal	Do	1-4-02	Rway segregation Camp	
Ghisty	nil	Warira	Medical Dpt	10-4-02	Compds quarters Room No: 6 Rway Hospl.	
Cooly	26522	Sadar Din	Accounts	12-4-02	Hospl Ward No: 1	
"	26125	Nadar Shah	Loco	14-4-02	Loco cooly landi	
"	21431	Budha	II Maint:	14-4-02	Came from Kikuyu	
Cook	nil	Kaloo	Medical	15-4-02	In a hut near Rway cooly Hospl. Kitchen	
Cooly	34794	Kaloo	II Maint:	29-4-02	Maintenance landi near Anti Sarg's bungallow	
Cook to Anti Surg		Shareef Khan	Medical	29-4-02	Cooly Landies	

Source: British National Archives, Kew: Ref. No.: MPG 1/1000/2(edited and improved by this author)

The lists in these two photos taken from the Medical Superintendent's records show the name of the person, their rank, the date when attended to, and theplace of residence. As it can be deduced from the names, most of the victims were Indian (coolies) railway workers. Three deaths were recorded at the railway quarters as shown. This perhaps contributed to the grand narrative of

associating disease (plague and cholera) with Asians and the adoption of the ideology of 'diseased peoples' in justifying racial segregation as a pattern of settlement.

As an institution, the railway had consolidated itself and, as earlier noted, they had more funds than the government. Being at a vantage point, they declined moving their residences from the plain to the hills. Consequently, the board recommended that a new bazaar be built on the site where police lines had initially been located as these had been moved to a new location. The railway bungalows were to remain where they were but to be subject to stringent sanitary inspections.[209] The bazaar operated as the commercial site for the city in what would come to be defined today as the Central Business District (CBD). However, congestion and the continued existence of the site without basic sanitary amenities, despite having numerous eateries and lodging facilities, made it an easy target for demolition on public health grounds.

While most recommendations of the board did not see the light of the day, a sanitary inspector was employed and a system of night soil removal adopted. The primacy of a good water supply system in ensuring proper sanitation was acknowledged and new efforts were put into augmenting a functioning safe water supply system for Nairobi. The characterization of surface water sources as inferior to ground water harnessing[210] guided the engineering practices of the time in the emerging colonial townships like Nairobi. It thus marked the inception of 'networked' systems of water supply and sanitation. Networked systems through centralized operations gained prominence. However, despite the efforts towards better water supply mechanisms, the threat of plague and other diseases associated with sanitation loomed large.

In 1904 another plague ravaged the township, and the medical officer of health, Dr. W. H. Macdonald, supported by four colleagues and, in agreement with him, the Commissioner, clamoured for the town's removal. A dispatch was sent to London in 1906 to this effect. Major (later Col.Sir) J. W. Pringle, Inspector of Railways attached to the Board of Trade, commissioned to make a final inspection of the Uganda Railway, said of Nairobi;

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[209]Ibid.

[210]Kooy and Bakker (2008).

> …as a station site, the level ground commends itself to a railway engineer. As a site for future capital of East Africa, and for permanent buildings for Europeans, the sanitary engineer and medical expert condemn it. Under the circumstances, I cannot but urge on His Majesty's government the desirability of further considering the question before construction of numerous buildings of a permanent type pledges them hopelessly to the adoption of a bad site.[211]

To reinforce the question of relocation, Nairobi's soil was characterized as not satisfactory. Impervious rocks were at places within a few inches of the surface of the ground. This made drainage a costly and difficult affair. It thus enhanced proneness to the dangerous disease outbreaks. However, the red soils, beginning on the foothills, was cited to be draining well and decomposing night soil rapidly, thus serving as a good foundation for construction. The suggestions for removal of the small town and re-establishment, some miles further upland, failed to gain more support.

Between 1902 and 1906, the question of removal of the site had attracted a huge debate, including the voices of two British parliamentarians, Herbert Samuel and John Burns, who were in support of change of site.[212]There was a huge tug between those in favour of and those against the relocation. Based on evidence from William Ross McGregor (who was the director of Public Works Department (PWD) from 5th April 1905, after a successful stint as a Uganda Railway engineer),[213] the question of relocation was mired in the politics of land speculation and control by the emerging class of settlers. McGregor singled out Ewart Grogan (who later emerged as one of the most powerful settlers who shaped the face of Nairobi in terms of land management, and many times seen as a trouble maker) as having been behind the clamour. To him, Grogan had

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[211] White, Silberman and Anderson (1948), p.12.

[212]Ibid.

[213] The Public Works Department had been founded in 1903 to coordinate the construction and functioning of major infrastructures key of which was water, roads and sanitation. Mr. R.M. Batey served as the first director of PWD assisted by three officials under the title of superintendents of public works. Mr. McGregor's appointment in 1905 also witnessed an expansion in the department's membership to 13 officers, mostly of European descent. see Nyanchaga (2016), p.34

annexed great chunks of land in the highlands surrounding the Nairobi township and as a land speculator; he wanted to cash in by selling it to the colonial authorities as they sought to relocate the site on sanitary grounds.[214] However, this needs to be understood against the backdrop of the out-right disagreement between railway administrators (read engineers) and colonial administrative officers, most of whom had only military experience, on how best to provide solutions for the sanitary challenges that faced the emerging township.

Several laws were passed through specific ordinances that zoomed in on sanitation. These were published through various notices in the East Africa and Uganda protectorates' official gazettes. Between 1905 and 1906, the medical officer of health, through bylaws enacted by the Township Committee,[215] gained enormous powers towards legislating on the sanitary issues of the time. Heavy fines were to be imposed on anyone found in breach of the passed legislation. The medical officer of health acquired sweeping powers to administer over matters of public health. The bylaws, apart from exposing the sorry state of sanitation in the Nairobi Township during the first decade of its existence, point towards the multiple technologies employed towards the amelioration of the threat to public health.

The bucket system of sewerage disposal was the most popular. This entailed the age-old system of using open buckets filled with ash and soil, and they would be emptied at night at an already identified location. A designated person, or whomsoever assumed authority at a household level, would do the emptying of the night soil. However, its inefficiencies are what popularized the need to adopt water-borne systems, especially on various public facilities and offices. Cesspools, pit-latrines, earth closetsand urinals were also in usage, and the sanitary inspector also acquired power through the referred to by-laws to sanction their construction as per the set standards. Despite these seemingly radical by-laws and regulations, the situation remained precarious, warranting the unending debate on relocation as pushed by various parties in the face of

[214] William Ross McGregor, letters to his mother, dated 13 May/26 June/3 August 1906, Ref No. MSS.Afr.s.2305, Papers of William Ross McGregor and Isabella Ross, accessed at Bodleian Library, Oxford.

[215] British National Archives, Kew, East Africa and Uganda Protectorates Government Gazettes 1905–1906, Ref No: Co 457/6

the reluctance of the railway officials, who were basically in charge of water infrastructure.

With everything coming to push and shove, a commission was appointed in the last half of 1906 to investigate the divisive issue of site relocation. A reputable sanitary officer, Sir George Bransby Williams, was appointed to lead the team of investigators. George Bransby Williams had a background in civil engineering, specializing in water, drainage and sanitation designs, and had worked on various projects in Britain, such as the Birmingham aqueduct. He was also concerned with railway civil engineering, thus gaining vast experience in South Wales and South Africa.[216] Despite the pessimism surrounding the Nairobi site, Bransby Williams indicated that Nairobi's water resources were better situated than anywhere else in the colony, with the availability of 'a million gallons a day' and the problem was that the resource had not been properly tapped.[217] He put an end to the debate on relocation and shifted focus onto the strategic provision of water, drainage and sanitation infrastructure. Together with a team of other experts from Britain and South Africa, Williams released his report in 1907, recommending a sum of £23,600, which was considered rather a large sum for a little town with an annual income of £ 9,100,[218] to lay out a water drainage and sewerage system.

Apart from strongly vouching for improved water supply, part of the sweeping recommendations by the Williams' Commission was the installation of a 9-inch flushing main pipe aimed at nipping in the budthe sanitary situation on whose account the commission had been formed. He further designed and carried out the main drainage and water supply for Nairobi through the three-year financial plan outlined in the commission's report.[219] Despite the Williams' Commission report being the highlight of the year 1907, the change of the colonial administrative headquarters from Mombasa to Nairobi presented a new vision for the location. Government institutions were more consolidated, turning the location into a beehive of 'modernist' activities. A centrifugal development pattern of key infrastructure, including water and sanitation,

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[216]See George Bransby-Williams (1872-1954) available at *https://www.gracesguide.co.uk/G. Bransby-Williams*Williams (1872-1954) went to become the sanitary engineer and head of the Public Health Department in Bengal from 1909 to 1927.

[217] Williams (1908), p. 19.

[218] White, Silberman and Anderson (1948).

[219]Ibid.

became necessary. Key buildings and facilities were the first to receive water and sewerage services in what became the central business district. Despite the knowledge of how important the systems were in terms of determining the future of Nairobi, universalization in provision was not a consideration. Even though race was not a primary consideration in provision of services at that particular time, compartmentalized settlement patterns informed the supply network. This skewed nature that bred inequality from the onset would haunt the Nairobi township, pulling it into another public health abyss in the immediate years that followed.

3.5 Planning for Water and the Obduracy of the Sanitary Menace: Williams' and Simpson's Reports

On the heels of Nairobi getting a clean bill of health from the Williams' Commission, it was clear that water paucity was not a challenge that would be easily wished away. To curb wastage and maintain water supplies, the Kenya Uganda Railways and Harbours Corporation (KUR&HC) introduced water meters in 1908.[220] This was the first time such technology was applied in the country, but instead of being used as a means of providing data on consumption and enhancing revenue collection, it was applied as a means of controlling usage of the scarce commodity by only allowing permitted quantities. Cases of technologies being used to institute behavioural change in the use of water were not new, as had earlier been demonstrated in Global North cities.

The inadequacy in supply saw the Muthaiga Water Company emerge in 1911. It was a private company, the first of its kind in colonial Kenya, charged with the responsibility of supplying around 500 households with water.[221] It had its own private connection network away from the municipal supplies that were managed by the railway corporation. Similarly, multiple non-networked supplies were instituted across Nairobi. Institutions like the Prince of Wales School (currently Nairobi School), constructed for the children of European railway officers, had sunk boreholes and reservoirs to provide water supplies to the adjacent areas.[222] However, these were seen as temporary measures, aimed at augmenting the system.

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[220] See table in Nyanchag (2016), p.33.

[221] *Colony and Protectorate of Kenya (1913–1923).* Muthaiga Water Supply. (KNA, Ref: AG/43/103, Nairobi, Kenya).

[222] KNA. Nairobi Water Supply. Ref.No: RN/6/38 (1939-1946)

The use of boreholes and shallow wells developed alongside the networked system of supply that connected basically to the railway premises and what were seen asimportant government premises, including the Commissioner's residence. The railway corporation supplied water only to its officials and other subsequent staff, mostly Asians located within the area that was of their jurisdiction. The emerging indigenous population was expected to be housed at the residences of their white colonial masters and, despite the emerging African settlements like Majengo – housing basically Swahili travellers from the coast of Kenya – no effort was made to provide water and sanitary services. Rainharvesting and river supply remained the key sources. As for sanitation, pit-latrines and opendefecation was still in favour, with large parts of Nairobi still thickly forested, offering privacy for such means, however unpopular. As indicated through oral interviews, particularly in Kibera amongst the Nubians, shallow wells and tributaries that feed into Nairobi River remained key to meeting the water needs of the burgeoning indigenous populations. This can be adduced based on the pattern of settlement within the valleys and along such feeder rivers.

As Nairobi quickly developed into an important colonial capital and an administrative centre for the East African Protectorate (later the Kenya Colony), the provision of water for both domestic use and railway functions became a key concern. In the same respect, issues of public health took precedence along the belief existing since the mid-19th century that those issues went hand in glove with a system of flowing or running water, basically through piped systems. This is in tandem with D.G.M. Roberts' observationthat a major consequence of the introduction of piped water in urban areas was the need for a sanitary drainage system. [223] For him, with minimal water consumption, insanitary conditions were frequently tolerated, along with other environmental deficiencies, but the piped water could rapidly become a nuisance and health risk. The only satisfactory solution thus was the provision of comprehensive systems of sewerage and sewage disposal.[224] While Nairobi's sanitary challenges of the early 1900s can be argued to have not been directly derived from its adoption of a piped water supply system, it is imperative to observe that problems mostly emanated from its inadequate supply. While many governments approach issues of water and sanitation

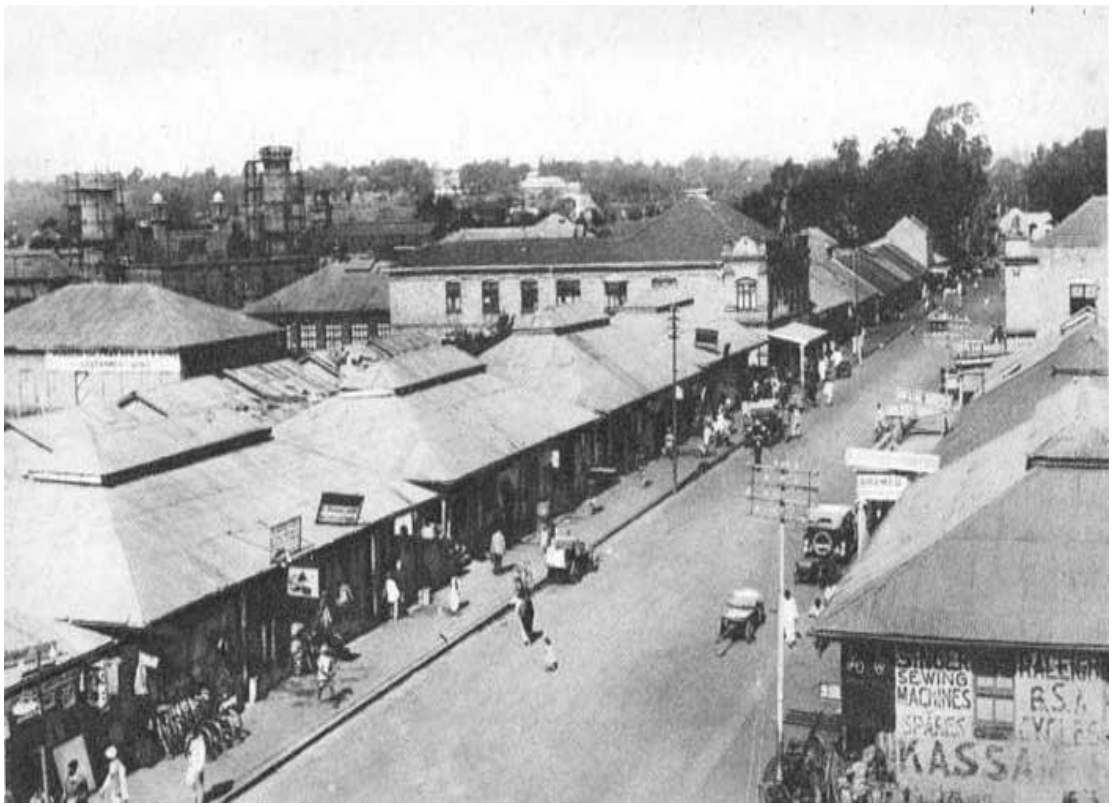
[223] Roberts (1971), p.365.

[224]Ibid.

separately, as proven by the persistent plague outbreaks in Nairobi, the two are closely related. A breakdown in the water supply presents a health hazard. The continued expansion of the Indian bazaar in the centre of Nairobi without the proper supplies of water and the means of getting rid of waste water meant looming outbreaks of waterborne diseases.

3.5.1 The Indian Bazaar in 1910: An 'eyesore' on the Nairobi landscape

Image 8: An aerial view of the Bazaar



Source: *http://www.sikhheritage.co.uk/heritage/sikhhert%20EAfrica/nostalgic%20EAfrica%20nAIROBI.htm*

The Indian Bazaar, established after the initial one was destroyed following the 1902 plague outbreak, occupied a core area that stretched along both sides of Government Road (today's Moi Avenue) all the way to the railway. As the town grew, the bazaar expanded towards the bed of the Nairobi River at the southeast end near Race Course Bridge. The area from River Road towards Nairobi River was known as River Road area. That lying between Government Road and River Road was the bazaar. The bazaar had blossomed into a multi-ethnic commercial hub and residential zone. But

the *ad hoc* nature of Nairobi's development without proper plans did not provide any incentive for service provision to this zone.[225]

Early in 1911, another bout of bubonic plague was reported, starting in the overpopulated and congested Indian bazaar. A public meeting was held and strong resolutions were passed calling for the immediate removal of the Indian bazaar. The highest colonial officer in the colony, Sir Percy Girouard, passed these resolutions to the Colonial Secretary in London.[226] This was not the first time the issue of removal of the Indian bazaar was featuring. It had been a subject of discussion for a long time, as evidenced through the letters and papers of the then director of PWD, William Ross McGregor. The major obstacle to effecting stringent measures was the government's lack of funds to relocate and compensate all the business owners in the bazaar, a few of which were Europeans.

Notwithstanding that, the new outbreak witnessed more concerted efforts in relation to pulling down the bazaar on the pretext of sanitation. The bazaar lacked the basic amenities to handle wastewater from the eateries and the residential houses leased out by the owners to the emerging urban underclass. It did not have proper drains and it had not been serviced by the piped water schemes, the latest of which had just been completed in the same year of the outbreak.

In May 1913, there was an administrative change in the sanitary department that saw a sanitary inspector's office established. This coincided with the appointment of Professor W. J. Simpson by the Colonial Office to look into the sanitary matters bedevilling Nairobi.[227] Simpson was an experienced health officer, who had worked in many colonies, including India. Specifically, he had been the head of the sanitary commission in Accra in 1909 and also Lagos. The Colonial office, hence, saw his reputation as vital in unravelling the persistent problem of plague that was threatening one of the rapidly emerging nodes for their East African interests. Going by what Simpson had recommended for Accra on the Gold Coast (Ghana), it came as no

[225] Murunga (2012).

[226] Bodleian Library, Oxford, *Nairobi Sanitary Report, 1913*-Ref No.753.12s.19

[227] Ibid.

surprise when he recommended racial segregation as one of the health policies for Nairobi. He had strongly argued against the indigenous water access methods that had thrived in Accra, racially terming them as primitive and placed the responsibility of providing WSS infrastructure for 'natives' on the white man, categorically stating that this was his burden.[228] It is such sentiments that reinforced the overemphasis on large centralized systems of infrastructure in nascent cities such as Nairobi.

Anchored in the principles of separated settlements and the belief in centralized systems as a panacea for the public health challenges in urban areas, Simpson's *Nairobi sanitary Report of 1913* legitimised the call for the removal of the Indian bazaar. Simpson's proposal for segregationist town planning was not a new phenomenon. It was a dominant paradigm practised across many territories in Africa, with Simpson himself at the centre. As Beeckmans states, at the beginning of the 20th century, a sanitary discourse was used as a pretext and for the legitimation of racial segregation in South Africa.[229] Swanson calls this phenomenon 'Sanitation Syndrome'.[230]Although in Dakar, Dar es Salaam and Kinshasa, 'Sanitation Syndrome' did not result in the creation of separate settlements for Africans miles from the city, as was the case in South Africa, it can be argued that it was, *inter alia*, under the influence of travelling British and South African doctors and sanitary officers that public hygiene and sanitation became a major concern for colonial administrations in these three cities, albeit with some decades of delay. Indeed, archival records show that local governments in Dakar, Dar es Salaam and Kinshasa applied to British and SouthAfrican sanitary officers, such as Prof. William J.R. Simpson, one of the founders of the London School of Hygiene and Tropical Medicine, for help and instructions with the planning of the sanitary belt.[231]

Moreover, Simpson's recommendation that a system of compulsory connection of houses with sewers be put in place alienated the urban underclass that could not afford such measures. As for the settlers, their privileged position both through enjoying

[228]Bohan (2010).

[229]Beeckmans (2013).

[230]Swanson (1977), pp.387–410.

[231]Beeckmans, 'Making the African City'; Dakar: ANS H20, 'l'Hygie`ne a` Dakar (1912; 1915)'; Dar es Salaam: TNA 3152, 'Segregation of Races (1920)'; Kinshasa: AA, GG 7.341, 'Hygie`ne zone neutre, se´parations entre populations indige`nes et non-indige`nes, expropriations.'

majority representation on the township council and their financial clout meant they received incentives to improve their dwellings through the laying of water supply and sewer connections, especially those people within the proximity of the mains supply lines. Moreover, the white populations through the variegated and compartmentalized settlement pattern occupied raised areas of Nairobi that had a decent slope for the natural drainage of water, hence,facing a minimum sanitary threat. Boreholes and septic tanks also remained ideal for some who occupied expansive areas like Karen that to date remains exclusively occupied by whites and upper-class post-independence African elites. Under the cloud of stern recommendations, the Indian bazaar was pulled down and a land re-allocation scheme in a new area that became Eastleigh was adopted. Eastleigh was earmarked as an 'Indian only' low density settlement, but nothing was done in terms of providing it with water and sanitary infrastructure systems, let alone roads and lighting. The casual way with which the protectorate government approached planning in Nairobi can be blamed for the challenges that bedevil the city to date.

Despite the disruptive nature of the First World War, the dire situation for sanitation in Nairobi meant that heavy projects had to be undertaken. The Williams' and Simpson's reports have openly been acknowledged as having constituted the first attempt at planning Nairobi and, indeed, they cemented the practice of approaching urban challenges by prescribing large technical systems of infrastructure. The first sewerage system that was adopted was a combined system handling both wastewater and surface rainwaters. As per the annual reports of the PWD for the financial year 1913/1914, their expenditure upon a recurrent works was £13,554, and new works, £34,090.The principal item among the new works was a more extensive instalment of the Nairobi Drainage System than had been put in any one previous year. A sum of £12,590 was spent on this work. The main sewer was completed from the intercepting chamber on Racecourse Road to the manhole at the junction of Sixth Avenue and Government Road.

Analysing these detailed accounts as they appear in the 1913/1914 PWD report shows that the heavy expenditure incurred by the Colonial Office indicated a determination to take precautionary measures in ensuring that the city that Nairobi was envisaged to become was attained. The removal of the Indian bazaar had 'cleansed' the city space and allowed room for proper planning. It goes without saying that the Williams'

reports of 1907 followed by the Nairobi Sanitary Report of 1913were the only plans for Nairobi as it limped along to become a major colonial outpost and city. Experts have widely agreed that Nairobi's problems had stemmed from a system of land acquisition marred by confusion, speculation and rent-seeking, over which the authorities had no control, which made it almost impossible to plan. Its development was haphazard, with no system of regulation in place. Hence, the adoption of the two reports laid the foundation for planning, especially for infrastructure.

3.6 Chapter Conclusion

This chapter has described how Nairobi's water and sanitation infrastructure systems developed from scratch under the jurisdiction of the Uganda Railway during the 1899 to 1920 period. I have demonstrated that, by Nairobi developing within the precincts of railway services and having been pioneered as a railway depot, there was a lack of authority to lay comprehensive plans that would nurture its growth as a city. The dual system of authority witnessed with its establishment as an administrative headquarter for Ukamba Province provided a real challenge in terms of the inception of key infrastructural projects. The government's lack of resources saw the railway authorities augment their position as water engineers, both at a technical and supply level, a position they held for close to two decades. Though Nairobi seemingly developed in an environment of neutrality, the key question to ask is how the consolidation of the water supply and sanitation worked and gradually reproduced an exclusive network. It results in the need to interrogate the question of the non-intended consequences of technologies as they are appropriated within society. Of importance to note is the non-integrated approach to the provision of water and sanitation despite there being a common understanding amongst engineering practitioners that the introduction of a piped water supply to the city must be followed by a system of getting rid of the wastewater. While the railway authorities led by assistant engineer William Ross McGregor instituted a water supply system from Kikuyu, a distance of about ten miles and within the popular tradition in Britain of the gravitation scheme, sewerage provision was in response to bubonic plague outbreaks that exposed the weaknesses in the planning of the new city. This was reactionary and insufficient perhaps because of being veiled in racial terms, judging by the recommendations by W. J. Simpson in his sanitary report of 1913. The combined sewerage design adopted for the pioneer works

would itself prove inadequate and limited. Furthermore, it failed to extend beyond the key government vantage points, further fragmenting its supply. In 1920, the East Africa Protectorate changed its status to the Colony of Kenya, hence, necessitating a major shift in the purpose and manner of water and sanitation infrastructure development in the rapidly growing Nairobi. What did this change entail and how did it inform future developments in water and sanitation provision for Nairobi? The next chapter grapples with this question, with the goal of pushing the normative debates on skewed infrastructure access beyond the binary framework of racial segregation in colonial Nairobi.

CHAPTER FOUR

MUNICIPALIZATION, CENTRALIZATION AND THE COLONIAL POLITICS OF INFRASTRUCTURE PROVISION: 1920 TO 1963

> *Our period of occupation did the country little permanent good, for all the selfless work of many devoted Englishmen and so many good intentions. Whatever the rights and wrongs of the way we left, whatever was to come after us, the time for us to be there was over. And if we were to go, it was better not to linger on. (Sir Humphrey Trevelyan, last High Commissioner of the Federation of South Arabia)*[232]

4.1 Introduction

At the end of the First World War in 1919, amidst the loss suffered by the Axis powers, the politics of colonialism were revisited and altered tremendously, with the Allies consolidating themselves in the occupied territories. The pre-war period had been occasioned by plunder, pacification, occupationand the consolidation of colonial rule.[233] On the other hand, the process of the actual establishment of an imperial and colonial state was slow and tumultuous. Resistance from below, harsh climate and terrain, non-existent communication infrastructure matching that of Europe, together with inadequate personnel, explained the slow start.[234] The pioneer years had been dedicated to transforming the conquered territories into viable colonial enterprises. This entailed instituting major infrastructure projects that would not only make governing the vast territories easy but also attract European administrators, investorsand missionaries.

As highlighted in the previous chapter, development of water and sanitation systems for Nairobi was conceived on the premise of a city facing a crisis of water supply and public health disasters. Concomitantly, it becomes necessary to re-examine the status of the territories along planning models, governanceand economic viability within the

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[232]Smitson (2010), p.1.

[233]Worger, Clark and Alpers (eds.) (2001); Cooper (2002); Bulhan (2015), pp.239-256.

[234]Illife (1979); Ochieng' (1983); Matson (1972); Muriuki (1973), pp.342-343.

broader prism of an imperialist endeavour. The triumph by the Allies renewed their vigour in their spheres of interest, where they embarked on a process of institutionalizing colonialism through domination, subjugationand socio-political and economic change. As the political engagement shifted from 'protectorates' to 'colonies' through various legislation, the dynamics of social relations and political administration underwent major shake-ups, reinforcing atavistic notions of European superiority. The Berlin Conference of 1884-85 had seen the European powers set into motion the occupation of their 'spheres of influence' as a way of, amongst many other purposes, averting a clash of economic interests that could have easily set them at war with each other. For the period leading into WWI, these territories that had been clearly marked as British, German, French, Portuguese, and Belgian overseas (African) territories remained as 'protected states', andhence 'Protectorates'.[235] However, with the end of the war, as noted, the Allied powers moved in to consolidate their influence by passing several pieces of legislationthat saw the declaration of the protectorates as colonies by which the indigenes officially and politically attained subject status.[236] In the newly crowned colonies, several ordinances (legislations) were passed on virtually every aspect of life to provide a legal framework that defined socio-political relations and governance in general.

Nairobi gained more credence and witnessed a concerted effort to anchor it as the East African 'jewel' of the vast British Empire. Infrastructural projects kicked off to serve the rising number of Europeans flocking into Kenya for various reasons. However, before analysing how these infrastructural projects, specifically the water and sanitation systems, were unfurled, it is important to revisit the question of infrastructures as *things* and how society interacts with them within a defined geo-political milieu.

Technologies of all kinds are produced and utilized by human kind for specific ends. This process is non-linear and it is never 'a dead end' affair.[237] The process of appropriation becomes a forerunner to either the shaping of the technology by the user or the re-construction of the user by the *thing*. Langdon Winner warns that those who

[235] Nilsson (2013)

[236] Ibid.

[237] See Hård (1993); Bijker (1995)

have not recognized the ways in which technologies are shaped by social and economic forces have not gotten far.[238]As he states, what matters is not technology itself but the social or economic system in which it is embedded. Interpretatively, this implies that the socio-political and economic milieu in which a technology operates reconstructs it either as a tool or artefact that carries meaning and reflections that are intrinsic to its form. To make this visiblerequires a context-specific analysis, yet at the same time, the inescapable manifestations that are universal to its operationalization come to the fore. Conventionally, historians and social scientists have tended to understand city governance and development under colonialism through the binary framework of racial segregation. However, the question of racial segregation needs to be stretched further beyond the Eurocentric and Schumpeterian interpretation of imperialism as a throwback to a primitive form of human behaviour.[239] Through atavistic justifications of the supremacy of the white race and categorization of indigenes as backward, barbaricand incapable of progress, the occupation and perpetuation of discrimination in the colonial state received legitimacy.[240] This was especially so from the white minority groups, mostly settlers and industrialists, who dominated the legislatures emerging in the colonies. Did these notions of domination, discrimination and social differentiation become embedded in infrastructural artefacts that developed as systems of provisioning for the emerging cities like Nairobi?

While it is not my purpose to reproduce Winner's theory of technological politics, it is his suggestion that we have to pay attention to the characteristics of technical objects and the meaning of those characteristics that I find enriching. If we are to understand the deficiencies that have characterized the adoption of large technical systems of water provision that defy the ultimate goal of either homogeneous urban-scape or universalized access reminiscent of the 'networked city ideal'[241] in cities like Nairobi, then adopting a nonconventional approach to interpretation is key to expounding on the already existing knowledge. The asymmetrical racial binary popularized in almost all understandings of colonial history tends to camouflage the character of 'migrating' technologies and creates a smokescreen for the push and pull of large technical

[238]Winner (1980)

[239]Kruger (1955), pp. 252-259.

[240]Childe (1950), pp. 3-17.

[241] see Graham and Marvin(2001); Graham (2010); Furlong and Kooy (2017), p. 901; Wamuchiru(2017)

infrastructure investments, irrespective of where they are instituted. Delving deeper into the issue of the meaning and recognition of the lack of neutrality in the shapes of technologydoes not require that we look for conscious conspiracies or malicious intentions.[242] Whether intended or not, the adoption and institutionalization of technical artefacts carries with it consequences for people as users. From Robert Moses' New York parkways and Baron Haussmann's Parisian thoroughfares to the 1960s and 1970s grotesque concrete buildings of brutalist form on American campuses, infrastructures have been seen as either intentionally or unintentionally tailormade to control, dominate or subjugate certain groups within society.[243]

However, this is not to say that infrastructures as artefacts are configured as divisive, discriminativeand oppressive. While they are envisioned as progressive and correctional to the dire socio-economic distress, for instance Edwin Chadwick's 19th century case of the poor working populations of England and Wales, it is at the level of implementation through deployment and usage that variations in access manifest themselves. Perhaps for Chadwick's Europe, the centralization and municipalization resulting from the technical being coupled with legal policy was the most effective way of achieving leverage in universalizing urban water and sanitation services to eradicate miasmas. In other cases, devolution or decentralization has been proposed as the most prudent way of addressing the weaknesses of the highly centralized and structuralist systems of urban infrastructure management. But all in all, the multi-layered nature and character of technical systems as entities need to be peeled off systematically for a broadened scope of analysis. From the Langdon Winner debate, the question of how certain forms of technology thrive within certain forms of governance emerges.

Historians of technology of the Hughesian school tend to assume that large technical systems follow a uni-linear path of development in the process of their deployment. They go through predetermined stages by which they gain 'momentum' to become self-perpetuating and the mitigation of what Hughes calls 'reverse salients' epitomizes their functionality.[244] The notion of the 'networked infrastructure ideal' emerges on the

[242]Ibid.

[243]See Robert (1975).

[244]See Hughes (1983).

presumption that by adopting large technical systems of provision, the cityscape is spatially equalized through a web of ubiquitous networks. But studies from the Global South reveal a vivid picture of fragmentation, decentralization and inequality in the systems of infrastructure access. Critical to how the map of access to urban infrastructure services are redrawn is the economic considerations that determine *who* gets what, *how*, *how much* of it, and sometimes *when*, as is the case with rationing practices common in the South.

In *City Water, City Life,* Carl Smith discusses what he characterizes as 'water and the infrastructure of ideas in urbanizing Philadelphia, Boston and Chicago' and uses the metaphor of water to expound on the social visualizations and public debates around the emerging technologies of water supply and water use.[245] Smith presents the bathing culture, which he observes to have been alarmingly un-American, through a water image that does not shy from the tension in the adoption of both public water pumps and bathing establishments or the quality of supply to the wealthy Bostonians. To advocates of universal access, providing water to all urban dwellers in cities becomes a moral question.[246]

In the analysis of the adoption of large technical systems of supply in Istanbul, Noyan Dinçkal amplifies the question on inequality embedded in the system of access in the form of the technical modes of supply and the physical landscape of access.[247] By using the analysis of what he calls 'reluctant modernization', Dinçkal examines the evolution of water from a 'free good' to a 'market or priced commodity'.[248] He sees this process of modernizing (read westernization) the Ottoman capital and the introduction of new urban technologies as a complex case of competing notions of the new (centralization, hence, commodification or marketization) versus the old (fountains as free water supply). While the bourgeois parts of the city receive a piped supply to households, the majority poor of the city enjoy communal access through public fountains, perhaps as a moral aspect to conform to religious uses of water. The dual system that emerges reinforces the aspects of the old versus the new that characterizes most cities in the

[245] Smith (2013).

[246] Ibid.

[247] Dinçkal (2008), pp.675-700.

[248] Ibid.

world. Retrospectively, the technologies of supply become not only symbols of 'modernity' to represent progress but they also metamorphose into social status symbols that distinctly reinforce zoning of the city scape into privileged and underprivileged areas. Universality, though seen as encompassed within the network system ideal, becomes a misnomer. If the adoption of LTSs in the Global North on a closer look shows aspects of inequality, tension and conflict, though at varied scales in a case by case basis, is it right to argue that the same scenario in the colonies derives from conscious decisions by policy makers and system builders to attain an 'apartheid' system of supply?

Duality in the urban sphere located within the matrix of infrastructural development is not a colonial or postcolonial phenomenon. Incidences of unevenness have perpetually manifested themselves as replicas of the implementation and deployment of LTSs. For instance, despite water resources being privately managed, London enjoyed an upper and lower supply system that linked to the underclass working population and the upmarket and industrial zones of the city respectively.[249]The dichotomization of the city, hence, spans far backwards beyond the institution of European imperial hegemonies. Arguing that colonialism proposed and succeeded at the re-ordering of urban spaces in the colonies in a segregationist manner reminiscent of a form of 'spatial apartheid',[250] tends to exonerate the infrastructures as artefacts that possess innate abilities to re-shape space and society, especially at the interface between their deployment and usage. If we are to adopt the common narratives emerging out of recent scholarship that colonial powers used and developed planning ideas, standardsand engineering technologies that had been invented to meet the requirements in Europe – hence the devastating imprint they have had on the colonies,[251]– is it, therefore, informative to analyse them through a racialized lens? Was inequality in deployment and usage exclusively a conscious colonial phenomenon?

In heeding Liora Bigon's caution, the colonial urban sphere should be seen as a constantly challenged and contested sphere rather than being perceived as a terrain for

[249]Tarr and Dupuy (1988).

[250]See Monstadt and Schramm (2014); Coutard (2008) and Gandy (2006), pp. 371-396.

[251]See Rakodi (2008).

exercising uni-directional power by those with formal political control over those colonized.[252] By exploring the contestations in the appropriation of both the space and technologies of infrastructure provision, it becomes possible to peel away the multiple layers that constitute urban spaces in a manner that is extensively informative. Rather than seeing inequality as deriving from an official racial policy of bifurcated planning, we have to concern ourselves with the potential that derives from the daily practices of the people as they strive to meet their water and sanitary needs. The cityscape is shaped by the lived experiences of its residents, both socio-politically and economically.

4.2 The Making of a Colonial Capital: Municipalization and the Dynamics of Water/Sanitation Infrastructure Development

As a contested space,colonial Nairobi provides a platform on which the unbundling of infrastructure systems and an understanding of how various technologies define not only people but also space become possible. The spatial binary of planned versus unplanned spaces is further reinforced by the nature of provisioning for basic services and the various technologies in play. The period commencing in 1920 witnessed major developments politically and economically. While Robert Maxon cites this period as having constituted an era of 'revolutionary advance' in Kenya,[253] it witnessed the extensive consolidation of colonial control that had racial ramifications. The script had been written to establish Kenya as an ideal settler economy. In terms of infrastructural development, the change of status from protectorate to colony harnessed more power in the office of the colonial governor, hence, diminishing the parallelauthority that institutions like the railway had exercised and maximized for their benefit. Kenya acquiring a new status as a colonynot only meant more political control by the metropole, it also implied shifts in the management of utilities and municipal governance in general.

Perhaps this was expected, with Britain having undergone similar shifts in management that had incorporated what was known as the 'civic gospel' and later became'municipal socialism'. In the late 19th century, between 1873 and 1876, Joseph Chamberlain – a

[252]SeeBigon (2012).

[253] Maxon cited in Ochieng'(1989).

local industrialist turned 'Radical Liberal politician' and mayor of Birmingham – energized both his career and the cause of municipal reform in Britain as he led Birmingham's municipal takeover of its gas and water works, reinforced sanitary improvements, took steps to improve workingclass housing, and even pressed for a thoroughfare through Birmingham's congested heart. [254] This mirrored what was happening in most British cities, and by the end of the 19th century, Chamberlain's 'civic gospel' had emerged as a critical model for European and American reformers, who argued that this concept of 'municipal socialism' represented a shift to the democratic provision of public goods and services; in principle, through 'mayoral activism', it translated into 'more work for the mayor'. A highly centralized and monolithic organization was arguedto be the most ideal one for rectifying urban service provisioning challenges.

However, Chamberlain's positivism with the 'civic gospel' model and 'municipal socialism' as represented by Birminghamwas criticized as a dangerous departure from the 19th century principles of laissez-faire and minimal government and highlighted the inefficiencies and abuses whichit was believed wouldensue.[255] Chamberlain's assertion that the 'civic gospel' model was an assurance for more democratic and inclusive access to urban social services was contradictory. Rather than promote equality through universal access, the infrastructure 'networks' resulted in inequalities in the supply outlay. In tandem with municipalisation, it followed that the greatest success was registered in the bolstering of municipal revenues instead of expanded access and usage amongst the citizenry. It took the combined influence of the sanitary movement and housing reform by 1900 to fast-track the introduction of water closets (WCs) and modern gas-fired kitchens for the majority of the urban underclass.[256]For the European colonies, the period following the end of WW1 witnessed the entrenchment of centralized governance, which included the establishment of the municipal monopolization of social service provision. With concerted efforts towards the municipalisation of utilities adopted for Nairobi in the early 1920s, how did this impact on a city that was witnessing high social tension both as a contested space –legally

[254]Gehrke (2016).

[255]Ibid.

[256]See Schott (2017) pp. 66-78.

Africans were unwanted in urban areas (Nairobi) unless temporarily employed either by European settlers or the government, yet the city provided an easy escape from the forced labour on settler farms in the interior of the country – and a multi-racial settlement faced with a shortage in key infrastructure, basically water? Was unequal access to water and sanitation infrastructure an intended consequence of the adoption of monolithic technical systems of supply or did it result unintentionally from the embeddedness of the techno-politics of infrastructure that manifest in the deployment of artefacts along socio-economic lines?

As expected, with the arrival of municipalization in the 'colonial capitals', it did not take long before there was disquiet, especially in cities like Nairobi, which was experiencing the inception of social stratification policies, premised on the Simpson proposals of 1913, as earlier highlighted. As the settler society sought to entrench its privileged status, the Asians were left competing for equal treatment in accessing key resources on the basis of their centrality in the nascent economy. Inter-racial tensions in Nairobi heightened between the various races sometimes played out in street demonstrations, as highlighted below.

In terms of the racial divide, Nairobi constituted a European community, people of Asian descent and African communities. As for the Africans, their makeup comprised the indigenes, otherwise popularly referred to as natives and non-native communities which included Nubians. Somalis had also found a home in Nairobi as livestock dealers who supplied beef and other products. The proximity of Nairobi to the Kikuyu countryside made it possible for Kikuyu traders to trudge into the city and back with their merchandise. Members from across other Kenyan communities came into the city to offer cheap labour, especially in the homes of the Europeans as cooks or 'shambaboys'.[257]

The colonial state had encouraged Indian immigration for technical support in railway construction and at the same time for the critical role Indian merchants played as

[257] 'Shamba boy' meant gardeners, and it was derogatively used for those in the city who took up such gardening jobs for little or no pay (in kind). These were adult African males, used in a similar fashion to the negroes during the slavery era to demean people of African descent.

tradesmen and money lenders.[258] The colonial state had expected the Indians to move with the railway into the interior and, thus, despite the challenges posed for Nairobi, the problems were expected to disappear with time. However, the Indian merchants took advantage of the emerging city and, led by personalities like A.M.Jeevanjee, they fought hard for representation and equal treatment in the colony of Kenya. Despite this effort, the colonial government, through the Secretary of State for Colonies, rejected the Indian quest for representation.[259] Racial and social divisions continued to take shape, with rising agitation from indigenes (as is highlighted below with the street protests of 1921), who were steadily making inroads into the fast growingcity.

4.2.1 The Asymmetry of Planning and Infrastructure Access: Race or 'Technomics' of Infrastructure Deployment?

Nairobi became very much politically charged as a space in the early 1920s asa result of various legislation adopted by the colonial state to consolidate their power. By replicating Lord Lugard's 1919 vagrancy laws as applied in Nigeria, the colonial state sought to control the influx of local communities into the city as a way of consolidating labour in the exclusive 'white highlands'. This introduction of the Kipande (pass) law and a system of taxation angered the Africans in the city and they organized protests in 1921 alongside the Gandhian principal of peaceful demonstrations under the leadership of Harry Thuku.[260] Such demonstrations were not construed within the purview of gaining political rights. Instead, they were basically an agitation for improved social services provision and an end to the harassment of the indigenes within Nairobi.[261] If equality was on the minds of the indigenes migrating into Nairobi, what did it imply as understood within the prism of better services in early 1920s Nairobi? Did better services for the locals compared to the Asians and the emerging settler community include abandoning indigenous social organizations, some of which procured resources like water? How did power relations shape the debate not only on social relations but also on interaction with various technologies on a daily basis as a lived experience? How did spatial zoning (see image 9 below) impact the deployment of key infrastructural outlays?

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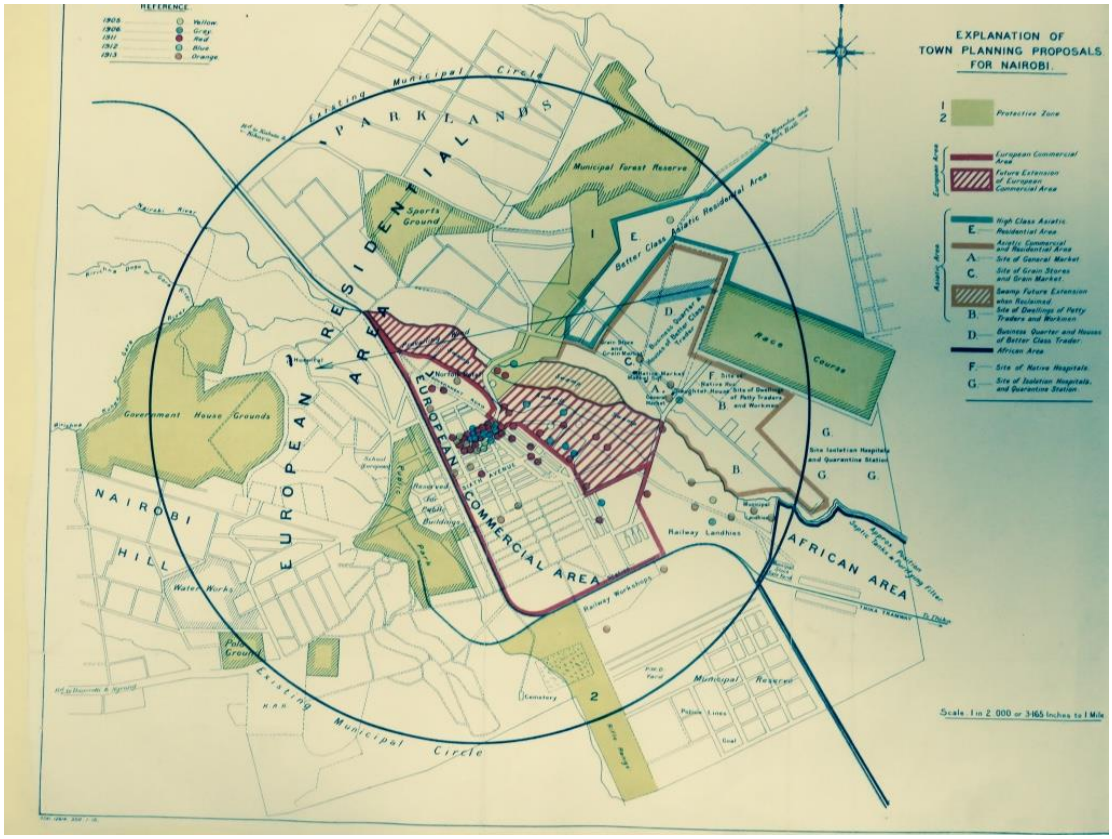
[258]For a detailed and concise overview of the role of Indians in the colonization of East Africa, see Metcalf (2007), Chapter 6.

[259] Aiyar (2011).

[260] Aiyar (2011).

[261]See Ochieng' (1983), Mwakikagile (2000); Aiyar (2011), pp.132-154.

Image 9: Zoned plan ofNairobi, 1920



Source: British National Archive, Kew, London. Ref. No:MPG 1/1114

This map shows the compartmentalized planning for Nairobi and the adoption of zoned land management.The spatial appropriation that demarcated Nairobi into exclusively European, Asian and the African area was popularized bySimpson's Sanitary Report,1913. The zoning came to inform the quality of housing, which, in turn, shaped the infractural access outlay. However, although the zoned landscape was racially defined on paper to encompass Simpson's outlook of what he saw as a panacea to the persistent plague threat, this thesis establishes that when it comes to the deployment of infrastructure networks, race might not have been of primary concern, and that differentiation arises as both the intended or unintended consequence of the process of technology appropriation.

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Harry Thuku was arrested and his arrest prompted demonstrations that turned confrontational in the face of the brutality of the police force. In the same respect, it is imperative to state that the colonialists envisioned Nairobi as a city that was exclusionary to the so-called 'native' societies and under a controlled labour supply; it remained a place of temporality. But to some Africans originating in the agriculturally intensive settler zones, Nairobi provided an escape from the demands of forced labour by the brutal colonial establishment. It is against this contrasting backdrop that Ianalyse the question of water and sanitation infrastructure development in Nairobi, and how the interplay between several actors, whether passive or active, reproduces not

only the water and sanitation scape but the totality of the city in terms of its bottom-up innovative potential. The multi-directional approach envisioned by this work becomes a possibility by the acknowledgment of the social diversity that is informed by the politics of control and domination, resistance and agitation, on the one hand, and state planning, on the other hand. By tampering with universal principles of city agglomeration and engineering practices, the water and sanitary landscape wasvery much informed by the realities of socio-economic and political contestation.

Even though segregationist planning was a popular dimension to colonial cities and wasentrenched through a set of ordinances, the Nairobi case paints a picture of a failed attempt that saw cosmopolitanism reigning supreme. Murunga, by focusing on the case of the Somali and Asiatics in Nairobi, vividly demonstrates that segregation was a failed project.[262] The physical development in Nairobi lagged behind the determination of rights and responsibilities in urban land ownership and use and this opened up avenues for inter-racial interactions that did not permit racial insularity.[263] Elliot Fitzgibbon, the municipal and town planning engineer for Nairobi, stated that common practice demanded that 'town planning must be based on a detailed contour survey for the whole area involved', but no such survey was ever taken for Nairobi.[264] With no definite town layout, infrastructure provision was reactive and outside of what could be termed as a visionary plan for the growing city.

The emergence of Nairobi had seen various communities assume certain relevance and establish themselves as an important cog in the growth and sustenance of the city. While white supremacist ideals reigned, most of European business community in Nairobi recognized the central roleplayed by Asiatics as shrewd business people, artisans, moneylenders, medicsand property owners. The Somali community was key to the supply of meat in the city and had also helped in the Kings African Rifles, offering security and helping with military activities. The Nubian veterans established in Kibra continued to enjoy some sense of preferential treatment for their military roles during occupation. As for the other indigenous societies, it was apparent that the

[262] Murunga (2012), p. 472.

[263] Ibid.

[264] Ibid.

survival of the Europeans in Nairobi relied on their ability to master European cuisine, and with limited technical resources, to be able to meet the dietary needs of the settlers. With such an inter-racial symbiosis, pursuing a segregationist agenda especially where development relied on haphazard decision-making and meticulous planning was non-existent remained a pipe dream.

The passing of legislations bordering on racial segregation was easy, but it was at implementation that the complexity of the situation, especially the fragile land adjudication process, rendered it futile. A case in hand is the attempt to evict the Somalis from part of Ngara and Parklands and the demolition of the bazaar by characterizing Asiatics as 'perpetually insanitary.' Specifically, the alleged incidence of smallpox in 1916 and 1917 had prompted the Principal Sanitary Officer (PSO) to advocate for the relocation of the Somali and their livestock to Mbagathi, which was presumed to have more grazing land. The real push for this attempted relocation was from the 'Chamber of Commerce', which felt that the close to two hundred Somali houses in an area reserved for exclusive occupation by high class Europeans was a threat.

While the administration hesitated in effecting this decision, citing the 'special privileges' enjoyed by the Somalis, the fact that they were wealthy and could afford to buy land and build their own houses connected to the key infrastructures of water and sanitation to meet the municipal prescribed standards made the decision untenable. The Somali elders, through their advocates, put up an argument that they had lawfully paid for the area they occupied in Ngara Plains. They noted that they had faithfully paid the Land Office for the area, and were better provided for with water and lighting in several of their houses.[265] The point is that this particular group of people enjoyed a tenure status they had lawfully paid for in terms of land rates and also were being supplied with water and lighting as a basic requirement that gave them 'legitimacy' in accordance with the city by-laws and building codes. This and many other scattered examples, such as Eastleigh, illuminate the fact that infrastructure provision and access in Nairobi were not exclusively preceded by race consideration but also anchored more on the financial clout of either the target group or individuals.

[265]Ibid. p.475.

By peeling away the networked large systems of water provision, contextually within the precincts of the colonial and postcolonial city, it becomes clear that although legislation on paper may read exclusion, infrastructure deployment followed a path that was more economically deterministic than racially engineered. This underscores one of the central arguments of this study. The asymmetry in urban infrastructure access extended beyond the 'apartheid spatialization' characteristic of the colonial urban state and, in subsequence, class differentiation in the postcolony. As high capital investments, do monolithic large technical systems gravitate towards universalization? Is inequality in the provision an embedded complex character of technological artefacts that manifests itself through the deployment process? Reflecting on how most projects were (are) undertaken for urban social service provision, amongst which is water and sanitation for early 20th century Nairobi, I note that the modality of provision for the colonial city operated on the basis of the consumer incurring the cost of connection and concomitantly being able to pay the rates as dictated by the billing system, for example, on a monthly or quarterly basis. This point informed all deliberations at the township and later the municipal committee level,and alsothe funding agencies at the Colonial Office in London, as demonstrated in the various minutes accessed from the archives both in Nairobi and London. A project's full adoption was endorsed on a cost-recovery basis and self-sustainability through paid-up rates. For instance, when the Nairobi municipality applied for a loan of £125,000to expand its waterworks (through various arrangements whose option included a loan from Balfour, Beatty and Company, or a proposed Land Bank which would take the loan and re-loan to the municipality), there was hesitation within the Colonial Office for the application of this loan, the reason being that the economic situation of Kenya did not justify it. There were also misgivings on the ultimate success of the Land Bank.[266]Deprived areas that could not enjoy a connection based on land tenure and which housed the urban underclass were either left to rely on the Nairobi river water while being intermittently supplied through a standpipe or a water bowser at a standardized cost.

As Nolte (2016) observes, infrastructure is an important governance tool that materializes planning as a process of inclusion and exclusion, territorialization, and de-territorialization. That is, infrastructure is decisive in a city and adds to the specific

[266] British National Archives (Kew), Ref. No: CO 533/459/2.

urban context in every city.[267] While infrastructure as materialized governance manifests itself and creates difference by how it connects and disconnects people, giving some legitimacy and rendering some illegitimate, as per the colonial municipal and local government ordinances, these manifestations underscore the non-neutrality of infrastructure systems and technical artefacts in general, without characterizing them as determinate. Nairobi was an emerging city that was conceived to serve the politically powerful and entitled group of white settlers. Therefore, its water and sanitation scape into the 1920s, in terms of technologies of provision and access, prevailed with aspects of racial exclusivity. However, this exclusion was engineered by the very nature of its deployment, thereby making it a question of class. In retrospect, this denotes race, as few or no indigenes enjoyed property rights to equally compete with the moneyed classes of Asians and Europeans.

Nonetheless, starting from the early 1920s, Nairobi was developed to serve the white European society by providing them with exclusive services to replicate the lifestyles back in the metropole's capitals. By virtue of their centrality in the thriving economies,the Asians in Nairobi enjoyed second-tier social status in most major urban centres as these capitals, especially Nairobi, remained as controlled areas for indigenous communities. Indigenes derogatively identified as 'natives' meant communities originating locally in Kenya further from the Somalis, Swahilis, Nubiansand Arabs, who were allowed to settle in areas such as Majengo, Pangani, and Kibra, even though they would later be targeted for demolition as the city expanded. Exclusion would entail legislation or coercion, either directly or indirectly, through harassment. Various pieces of legislation, such as those that controlled African movement and employment, housing or building codes, land ownership and purchase, and urban infrastructural standards, were purposely crafted to make it difficult for Africans to move into, live and work in urban areas like Nairobi.[268] As for Nairobi, if the idea of the city and its planning did not envision the presence of natives and their permanency, is it a tenable state that the race perspective of infrastructure access exclusively explains the inequality and spatial differentiation witnessed in its infrastructural development?

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[267] Nolte (2016), p.452.

[268] Falola and Salm (2005).

Despite social segregation being a major aspect of urban planning practices in most cities during colonialism, the access to water and sanitation services, just like many other major infrastructure systems, manifested itself in a variegated outlay that connected certain nodes while excluding others, as arising from the economic considerations. The payability and affordability juxtaposed with the viability of the respective technologies determined who got what, howand how much of it they received at any particular time. And for a city that had been acknowledged in the Williams report of 1907 and Simpson's report of 1913 as having perennial water crises that was compounded by the growing populations, the most pertinent issue was not only the modalities of provision but also the question of cost of expansion vis-à-vis financial soundness. By 1919, as indicated in the colonial report (1919/1920), no waterborne sewage disposal schemes were in operation in any of the towns in Kenya as a general measure, though in Nairobi there was a growing tendency for private individuals to use a septic tank system. What this means is that sewage handling in Nairobi operated more on a 'do it yourself' basis, hence, a non-networked or fragmented outlay. Disposal basically involved dumping of the night soil at designated areas, and trenching, incineration, cesspool collection or distribution on the ground, especially from congested areas like the Indian Bazaar, making it a target for demolition as had been proposed in the two sanitary reports (1907 and 1913). Further developments in Nairobi, for example, at a factory and godown areas, meant that a waterborne system of disposal and treatment with an element of irrigation was necessary.[269] By Nairobi lacking a well-coordinated development plan during its first decade, a lot of initiatives remained individualized, fragmented and bottom-up. The network of small rivers that had motivated the railway corporation to set up base at the location meant that these rivers remained primary sources of water, especially for the emerging class of 'interlopers' from the interior. This is because the Kikuyu Springs mainline supported by private boreholes continued to cater for the increasing number of white settlers and Asian traders. At this point, paucity in the water and sanitation supply system for Nairobi was a manifestation of a city that had been subject to haphazard land adjudication and uncoordinated infrastructure development. The differentiated and

[269] East Africa Protectorate (Now known as Kenya Colony and Protectorate) Colonial Reports-Annual, No. 1089-Report for 1919 -1920

asymmetrically bifurcated modalities of access spanned the deep-seated racial divisions and tension that characterized most urban areas in the colonies.

Apart from the railway base and a few colonial administrative amenities, British tourists and settlers initially explored Nairobi as a first-stop and a leisure point for biggame hunting expeditions. This had seen the earliest physical development target establishment of a thriving hotel industry. The compart mentalized development of infrastructure to target government facilities, the business districtand the social facilities, such as hotels, theatres and cinema halls, meant that the areas outside these marked zones either had to independently connect to the main lines, especially for water, since little progress had been made in large systems of sewage flow or they had to rely on 'own initiatives'. These case scenarios continue to defy the long held race binary in the period leading to the 1920s in most colonies in sub-Saharan Africa. It is the immediate post-First World War age that brought to the fore the racial ramifications in planning and urban management. In line with this, both politics and socio-cultural constructs interactedto make technology and infrastructure systems visible. By entrenching European control and domination over Kenya, and Nairobi in particular, the political dictates of the enactment of a colony from protectorate in 1920 manifested itself differently at various levels in makingthe city an urban space. However, the political question of who gets what and how would be interwoven with the overriding principle of means and modes of funding for technologies in infrastructural developments.

4.3 Protectorate to Colony: Race, Power, and the Infrastructure Divide of Water and Sanitation, 1919 to 1939

By an order in Council dated 11th June 1920, the East Africa protectorate was annexed to the British Dominions under the name of the Colony of Kenya.[270] The difference this made was that while under the protectorate status, the territory had existed with some form of autonomy despite being under British occupation as their 'sphere of influence', acquiring colonial status meant that the territory was now under the direct rule, controland domination of Britain under the Colonial Secretary in London, who was represented in the colony by a governor. The indigenes were mere subjects of the

[270] *The Geographical Journal*, Vol. 56, No. 5 (Nov., 1920), pp. 403-411.

Crown, as explained in the Order in Council (Law) that established the colony. The governor answered directly to the colonial secretary, and the Colonial Office in London approved major legislation and budgetary estimates, allocationsand project implementation. However, the Legislative Council (Legco) that was dominated by white settlers, a few Asians and one representative of the Arab community made laws for the colony locally plus deliberated on several issues affecting the colony directly. Africans had no representation and their issues were purported to be handled by a white missionary who himself was a foreigner, presenting a huge paradox in governance. At a political level, the establishment of the colony of Kenya brought racial hostilities to the fore due to the dispossession of Africans of their land and with Asians whose number had substantively increased, disputing the restriction of their membership in the Legco to only two non-elective positions.[271] It is within this politically heightened environment in Nairobi of 1920 onwards that major infrastructure developments reminiscent of a colonial capital continued to take shape. The process of annexation continued and the power struggle between the settlers and Asians alongside agitation by indigenes for improved living standards and fair treatment in Nairobi formed part of the major discussions.

The colonial consolidation of power for Nairobi came with the adoption of the Municipal Corporations Ordinance of 1922 that saw the city acquire the status of a municipality governed by the Municipal Council.[272] In creating a municipality, the Colonial Annual Report of 1920/21 identified increased water and treatment as the greatest challenge to Nairobi.[273] It was clear that the water situation needed to be addressed immediately. As earlier noted, it is imperative to emphasize that Nairobi in terms of race envisioned the non-existence of long-term indigenous inhabitants as a mechanism of keeping cheap labour on the settler farms for maximum agricultural production. It had been proposed that the few Africans in the city would reside on their employers' plots, where they served as gardeners, cooks, and 'house boys'. This is important to mention as Nairobi has to be seen as a capital in a colony where race tensions and dynamics stand a greater chance of being well articulated by

[271] Gatheru(2005).

[272] KNA., Ref. No. k.352.91 REP.

[273] The Colony of Kenya, Annual Report 1920/21. Accessed online at http://libsysdigi.library.illinois.edu/ilharvest/Africana/Books2011- 05/5530244/5530244_1921/5530244_1921_opt.pdf

acknowledging that the settler economy that was the backbone of the country – where lots of prospects had been placed on mineral wealth and yet little existed – thrived on making the city 'exclusive'of locals as their labour on farms was of paramount importance. When we talk of 'spatialized' planning, especially in the pre Second World War age, we must take cognizance of the realities that informed space, urbanityand the presence of indigenes in urban spaces. Racial segregation in the urban spatial planning of cities in Africa during colonialism cannot be understated, as evidenced by works from urbanist historians and commentators like Njoh (2007) and Freund (2001; 2007) to show how cities took shape to connote the racial binaries of dual cities[274] or sometimes triad and quad cities, where Asians, Arabs, and the so-called 'natives' existed.

Rather than conforming to the conventional network city model that presumes the inter-link and inter-connection of all nodes that converge as the respective urbanscape, the economic side of infrastructure provision reproduces differentiation, whether as an intended or unintended consequence of deployment of certain technologies. Only those who can afford to meet the cost of individual connection and its sustenance through monthly or quarterly billing systems as facilitated by adoption of water meters, based on consumption or negotiated flat-rates, get to enjoy the services. This defies the universalization principle, as the under-class or 'politically in-correct' of the city are left to survive on 'do it yourself' approaches or other non-streamlined methods that fall within the purview of either indigenous or localized modes of provision and access. All in all, the early 1920s marked both political and administrative departures in the new colony, and Nairobi became a focal point for consolidation and dissemination of mostly travelling ideals in technologies of infrastructure development, most of which were centralized large technical systems of water and sanitation provision for the new municipality.[275]

How did the municipalization and centralization process in Nairobi unfold to shape the water and sanitation scape in the interwar period? If the purpose of the British government in changing the status of the former East Africa Protectorate into the Kenya

[274]NJoh (2007), Freund (2001), pp. 527-46; (2007), see also Mabogunje(1981).

[275] For more on this development, see Nyanchaga (2016) and Nilsson (2011).

Colony in 1920 was to consolidate state power, then Nairobi as a capital became a hub for colonial ideals, part of which is the 'modernist ideal' of a 'network city'. The 'networked city' ideal's facets mesh into interrelated nodes that are manifested throughthe technological design and topology of cities integrated, ordered and confined by universal infrastructure networks that organize the exchange of goods, ideas, waste, powerand people within and between urban territories, and which define the boundaries of an urban territory; (2) the notion that urban monopolists provide for a ubiquitous and standardized infrastructure services (or for 'public utilities'); (3) the notion of passive customers that are not actively engaged in the production of infrastructure services; (4) the assumption that the provision of infrastructure services is closely attached to, or highly regulated by, the state; and (5) the concept of urban planning effectively regulating land use and guaranteeing the universal provision of critical services[276] As positivist and ambitiously assuring this ideal looks, its translation, especially as dictated by supremacist racial politics in urban spatial planning in the colonies, presented a variegated infrastructure landscape as opposed to its goal of universalization and the assumption of users being passive recipients was its greatest undoing. All in all, the implantation of centralization in development and management of the water and sanitation infrastructure for Nairobi amongst others presumably gained momentum with the 1920 declaration of colonial status.

In a meeting on 17 October 1921, a draft water supply agreement was adopted subject to alteration. It proposed to address the question of water payments. The proposal was that payments be made quarterly rather than monthly. It further outlawed free repairs on standpipes, perhaps with the aim of streamlining water provision on a much more responsible basis, informed by returns on investment which can only be achieved through a highly centralized system, atleast going by the aims of those who believed in the 'civic gospel' ideal. As it became clear that the rapid move towards municipalization intended to streamline revenue collection, the efficiency and efficacy of water meters installed emerged. Government institutions such as the Kabete Research Laboratory reported the underservice of the system and proposals for the increased diameter ofthe mains pipes were discussed. On the floor of the same meeting, a letter from one resident, a Mr. L. Gilbert, brought into question the quality of the

[276]Dupuy (2008), Monstadt and Schramm (2013), Coutard and Rutherford (2016)

water being supplied by one of the mains, pointing out that if was dirty, a price reduction on it should be effected.[277] All these brought into the limelight the complex problem of water paucity and its obduracy for Nairobi, irrespective of the creed or colour of the user.

To further pursue the agenda of centralized supply system, in 1922, the municipal corporation bought the Kikuyu Springs from the Uganda Railway at a cost of £20,000 and, subsequently, acquired the Muthaiga Water Company that had been formed in 1911 as the first private water undertaker in Nairobi.[278] While the takeover instituted monopolization, which was believed to bring about efficiency in the supply system, this move could be interpreted as one of wanting to augment the revenue base for the young colony and at the same time harness political power that could be wielded through influence of private entities or corporates controlling key resources like water.

However, apart from the state's political and economic assertiveness being achieved through this shift towards municipal centralized systems of infrastructure outlay, the 'networked city ideal', which has been defined as an ensemble of interrelated components, as known and practiced in Europe and North America failed to materialize. This was either not proposed, as demonstrated through segregational socio-spatial planning, or it failed as a result of the embedded nature of technologies that reproduce and shape urban topologies to sometimes exhibit unintended results. Proponents of the 'network city' model, as it sought to be replicated in the Global South by colonial states, argued that it was the most efficient means of supplying urban services and that the panacea to the problems created by the networks resided within the networks themselves, for example, in their expansion or universalization, more centralized management and increased technical sophistication.[279] This was within the suspicious atmosphere of racial tension, especially between the emergent powerful settler community and the Asian society, which felt greatly disadvantaged by the new developments that curtailed their control over land.

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[277]KNA, Ref: RN/4/63, Nairobi, Kenya.

[278]KNA, Ref: AG/43/103, Nairobi, Kenya.

[279]Coutard and Rutherford (2016), p.3; see also Monstadt and Schramm (2017)

But perhaps the interesting question to ask would be that of how the move towards centralization reproduced the city of Nairobi socio-spatially. Popularization of this model had implications for the users and even for the authorities in terms of the cost of managing and procuring services for a population that was perpetually expanding. Contained outbreaks of plague also meant less deaths registered, hence increasingthe internal growth. How did this, therefore, inform the access to services? Did it preconceive a racial provision or did the strain put on the water and sanitation system imply the criticality of the said infrastructural systems?

Water paucity persisted and, while the government pursued options of increasing the capacity of the Kikuyu Springs, many institutions in the city sunk boreholes as backups to the unreliable erratic supply to areas like Parklands (dominated by Asiatic communities). In the face of water shortages, private boreholes and shallow wells doubled up to meet the demand for water in Nairobi. Several Europeans on expansive plots drilled their own boreholes. The Muthaiga community, which was predominantly white, had been amongst the most proactive (founding their own private water company before it was taken over by the municipal authorities) and the Muthaiga tank remained a viable source of supply off the main grid. The municipal would refer clients to apply for supply from this tank. It was the scenario that saw the Agricultural Society's application for more uptake from the Muthaiga tank approved on condition that they installed storage tanks that would be filled at night so as not to disturb the town supply. With such fragmentation or disaggregation, the early 1920s tendency clearly defies the 'network city' ideal and makes us ask whether the Global South cities have or could ever be drawn into the ideological debate around networks and universalized infrastructure systems.

The modality of provision was dual in the sense that the colonial government did the mains supply and left it to the prospective consumers to do subsequent outlays. By the Colonial State doing mains supply systems that only connected to public amenities and government facilities, and requiring that the cost of individual connections be incurred solely by interested private citizens, the deduction made was that the infrastructure system followed a pattern of deployment that was shaped by economic class rather than race. Spatial appropriation also shaped the pattern of modalities of provision to be

adopted. For instance, Karen, which developed as a posh and exclusively white residential area, relied on boreholes with overhead storage tanks and septic tanks for liquid waste management alongside municipal provision for those who lay within reasonable proximity of the mains supply.[280]Karen Estate was an expansive and serene area, which employed ranching land-use practices. Its exclusively white settlers kept horses for racing, and the most viable means of social service provision were either individualized or made communal through landowners associations (Karen Estate Company).[281]However, this is not to dispute the segregated spatial planning approach that gave an advantage to majority members of the minority white race in Nairobi. The race dynamics were merely augmented by the fact that the colonial economy was in the hands of the minority Europeans and Asians. It can be argued that consumption figures show the racially categorized needs of supply in terms of capacity, with the minority of European society enjoying a greater supply than the majority Africans, to be driven by multiple factors rather than segregationist policies. It is imperative to note that the concern over shortages was not a racial problem. No records of mobilization along racial linesfor demand for supply exist so far and with critical institutions like the Agricultural Society that was dominated by the most powerful settlers in the colony facing the same challenge, the municipal councils response remained hinged on the interested parties incurring the cost of connection, piping and storage facilities.

One regrettable factor is that despite the lack of funds by the Nairobi City Council (NCC), water provision seemed to enjoy more primacy compared to sanitation (a tradition that continues up to this day as it will be shown in this work). The colonial report in 1919 noted that there was no scheme for waterborne disposal in operation in any of the towns in Kenya as a general measure; although in Nairobi, there was a growing tendency for private individuals to use septic tank systems. It was further identified in the report that a movement was underway to dispose of the sewage from the new factory and godown areas in Nairobi by means of a waterborne system and septic tank disposal and subsequent irrigation. In 1923, sanitation was conceived as a housing problem and the solution centred more on providing descent housing. In 1922, the government had put up a few huts for ‘natives’, believing that these would serve as

[280] KNA. Ref. NO. RN/6/38, Nairobi, Kenya.

[281]Ibid.

a model for other towns. Unfortunately, in 1923, the public money available was insufficient for the institution of any ambitious sanitary improvements, but progress on modest lines had been made, more especially in the provision of improved quarters for natives in towns. Housing policy for the city, as explained through the municipal building codes, directly impacted on water supply and sanitation management by explicitly setting certain minimum standards.

The housing scheme for the Africans in Nairobi, which had been under consideration by the Nairobi Municipality for some time, was not brought into effect during 1924. An advance of £16,000 to the municipality had, however, been sanctioned for this purpose and before the end of 1925, a considerable amount of good and healthy accommodation was expected to be available. Activity continued throughout the year in the general improvement of sanitation in the larger townships by the staff available for this purpose, and in Nairobi, a small public health museum was opened to the public in which were displayed type plans for African housing models of septic tanks, and other subjects of public health and sanitary interest, which, it was hoped, would prove to be of benefit to estates on which large numbers of 'natives' had been employed and housed. To conceive the sanitary interventionist measures from a building perspective would serve to propagate the preference for closed circuits or waterborne means of getting rid of wastewater and faecal matter.[282]

Sanitary matters received more lip service than any concerted efforts to have functioning and reliable systems of sewerage management which covered and cut across the city. Dr. Gilks, the medical officer, recommended the early appointment of a sanitary engineer in Kenya in his 1925 medical report.[283] The committee endorsed this recommendation and also those made emphasizing the necessity for ensuring that all building or engineering plans which had any bearing on health were to be approved by the competent medical authorities prior to execution. Dr. Gilks expressed the opinion that the bad housing conditions in many parts of Kenya, Nairobi included, had in the past been the cause of much ill health amongst both the European and the native populations.

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[282] Colony and Protectorate of Kenya, 1923 Report, accessed at SOAS.

[283] Medical Department Annual Report, 1925, British National archives, Ref. No. CO 533/652.

In 1926, by-laws were passed aiming, inter alia, at ridding the town of undesirable natives, while, at the same time, affording all proper protection to those who had come into the municipal area for employment or other lawful purpose. Numerous cases of plague occurred throughout the year in Nairobi; they were almost entirely confined to those parts of the town in which housing conditions were notoriously unsatisfactory.[284] In 1927, the Local Government Commission produced its report on the water situation in Nairobi. Acknowledging that the Nairobi Corporation was already in provision of a water supply for a considerable portion of the sub-urban area outside municipal limits, the report pointed out 'the necessity for a single system of water supply for the entire urban and sub-urban.' [285] In November 1928, the Nairobi City Council Works Committee highlighted the plight of the residents of one of the purported sub-urban areas of Nairobi, Eastleigh. With the recommendations of the Simpson's report of 1913, as noted earlier, the Indian bazaar had been demolished and Eastleigh created to accommodate those who had been evicted from their premises so as to diffuse the tension that had always characterized the removal of the bazaar. Eastleighsprouted up as a low-density area and continued to rapidly grow as a middle-income residential settlement. Earlier on in 1920, it had been estimated that Eastleigh had a population of 55 Europeans, 550 Indians, 120 Goans and 400 Somalis.[286] Its multiracial character set it apart, though by law it had been earmarked as an 'Indian only' settlement.

However, as calamitously as it could be, Eastleigh remained disconnected from the town area without any basic infrastructures. Residents continued to draw water from shallow wells that dried during dry seasons and faced constant pollution.[287] If the idea was to remove the Somali from Ngaraso as to conform to the segregationist ideas outlined in the *Sanitary Commission Report of 1913*, the Somalis circumvented it by making their private arrangements to buy residences in Nairobi East Township. Eastleigh was proclaimed a township by gazette notice of 13 April 1921, which was an amalgamation of the former Egerton Estate, the Nairobi East Township and the area

[284] Colony and Protectorate of Kenya, 1926 Report, accessed at SOAS.

[285] KNA, Ref. No. k.352.91 REP.

[286] Ibid.

[287] KNA.,REF. No. k352.91 REP.

known as Egerton, Eastleigh, and Eastleigh Extensions.[288] This amalgamation meant that what had been earmarked as a segregational residential area exclusively for better class Indian artisans, tradersand workers was now a cosmopolitan or, at best, a multi-racial area.

The Eastleigh Association made requisition for a water trough for their oxen but the corporation demanded surety of payment and security to ensure no wastage of any kind. House owners grappled with the challenge of providing metered water to their tenants but the corporation put the onus of supply to them, offering only to sell meters for the landlords to institute their own internal connections, which would be at their own liability.[289] This, therefore, continues to reinforce the perspective that the rolling out of the water infrastructure strictly depended on economic factors. The municipal authorities' concern primarily relied on harnessing returns on one of the major investments for water provision. Municipalization, as demonstrated during the initial years of its application in cities in Europe towards the end of the 19th century, succeeded in bolstering revenues rather than promoting universal access to social services.[290] For the colonies, 'decentred' or indigenous modalities persisted along the developing 'networked ideal'.

Sinking boreholes and shallow wells for those who could not afford or lived far from the network wasa common phenomenon. Such bottom-up approaches reinforce the 'complementarity ideal' attested to by the self-provisioning models adopted, including the posh areas like Karen. Thus the variegation in Nairobi's water and sanitation infrastructure did not solely result from neglect of the 'unplanned' and poor areas of the city that were settled on by the majority of Africans but also fromlanduse practices.

In terms of development of infrastructure for water and sanitation for the fast-growing Nairobi, the hitch in funding was a major obstacle and perhaps it reinforces the argument that deployment of infrastructure has its pivotal component in its financing. Archival evidence points towards the Colonial Office in London being reluctant to

[288] KNA., MOH/1/3932.

[289] KNA., RN/4/63.

[290] See Schott (2017), pp.66-78.

undertake any financial commitment for the municipal authority in Nairobi. For example, several proposals for augmenting Nairobi's water and sanitation supply were turned down due to the precarious financial position of the Nairobi Municipal (later City) Council. Where loans were granted, the colonial government had to be an enjoined party.[291] The lack of financial autonomy for Nairobi, therefore, inhibited its ability to expand its networks in the true sense of 'universal service provision'.

The water crisis in Nairobi operated like leprosy, never going away and soaking up all efforts only to reappear as the city burgeoned with an increased population and growing economic and political status. In 1930, there was a sense of urgency in seeking expert opinion on thewater supply for Nairobi. Specifically, the Nairobi office requested the electric engineer, who was then working on a hydro-electric power project referred to as 'Seven Forks', to advise on the supply of water for Nairobi. It proved improbable but reappeared with the order for Zanzibar. The Nairobi office noted that it was clearly desirable on grounds of economy and efficiency that the same expert should advise on the Zanzibar and Nairobi problems. It was envisioned by the city officials that the proposed Nairobi water and sewerage scheme would become self-supporting by 1941 if construction was completed in 1934. An average annual loss of approximately £4,500 was anticipated for seven years, the bulk of which would be met from reserve funds. Its viability would, if necessary, consider the increase in the prevailing tariffs at the time. The net annual profit of the scheme ultimately could not be stated. Sadly, it was highlighted that the sewerage scheme would probably never be self-supporting. The direct revenue from sewerage connections was, however, anticipated to cover approximately half the gross annual expenditures. Despite these estimates, funding for the scheme was not forthcoming.[292]

The acute crisis of water in Nairobi meant exploration for distant sources, as was the practice in most cities globally. Along such lines, the proposal to takewater from Ruiru River, 30 miles from the city centre, was tabled.[293] Stiff opposition emerged from the riparian agriculturalists. The water ordinance of 1929, being the law that governed

[291] British National Archives. Ref.NO. CO 533/459/2, Kew, London.

[292], British National Archives Ref. No. CO 533/416/5,Kew, London.

[293] KNA., CUP:307.76SMA.1950.

water resources and their usage, was found to be wanting.[294] First and foremost, it did not address subterranean water. Secondly, it entailed elaborate hydrographic measurements and a large personnel team was needed for the same. Thirdly, there was no provision for the payment of fees for the extraordinary use of water. Fourthly, it was noted that the ordinance gave much power of a quasi-judicial nature to a semi-bureaucratic body. Lastly, it exempted the government water board and their officers from any liability for any actions. To answer to these flaws, an amendment was made to empower the water board to act independently in ensuring the conservation of water resources and good management for whichever purposes, including the building of dams. The streamlining of the law allowed for the amicable handling of the opposition to the Ruiru project by riparians.

As the Kikuyu supply choked under the pressure, the Ruiru River works commenced in 1935 and were completed and commissioned in 1938. Much as it boosted the supply system, the requirement that individual applicants incur the cost of piping and equipment from the main lines to their premises meant that only the rich and powerful would enjoy the service. The interplay between class and race massively shaped how the network for water and sanitation access unfurled through the deployment of the artefacts that constituted the key infrastructure systems. The differentiated provision of water and sanitation services in Nairobi had much to do with the lifestyle and socioeconomic status of the various groups that occupied the city. A poor European in Nairobi faced the same challenges as an Asian or African.

Conventionally, the Chadwickian systems of sanitizing and developing healthy cities carried with it a financial burden and the infrastructure finance system supported by loans, prompting the authorities to develop a cost-recovery component to access and provision. The funding and ability of the public to pay for such services would shape how the artefacts would be deployed to improve access. The end goal was not universalization, as envisioned by such systems in the Global North, but the thriving of the city based on multiple modalities of supply and access, though sometimes socio-spatially situated to the advantage of some compared to others. As such, it is not a question of either centralized or decentralized, monolithic or variegated, networked or

[294] Water Ordinance No. 35 of 1929, Ref. NO. CO 533/396/13, British National Archives, Kew.

fragmented, connected or disconnected systems of supply. Rather, the large technical and networked systems come with deficiencies resulting either from the process of deployment that is dictated by politics and economics of provision and the user or human agency from below. This is explained by the persistency of the indigene/old or counter movements to the adoption and adaptation to the new that manifests itself as a complementary outlay in the stabilization of urban services, despite the crisis for some societies. The infrastructure landscape presents a quilt of provisioning ideals rather than a large technical monolith from top to down.

4.4 The (mis)Fortunes of the 2nd World War: Expansionist Approaches to Water and Sanitation Infrastructure Provision

As the Second World War erupted in 1939, cities in the European colonies like Nairobi were presented with new challenges. Nairobi had assumed an imperial importance in the Second World War as the headquarters of the East African Command and the base of East African troops for the Abyssinian campaign, the Middle East and the Asiatic theatres of war. Nairobi was launched as a 'big city',which was reflected in its social service expenditure, the increase in rates and the expansion in staff. The demographic impact seemed to be overwhelming for the city. Serving as a military regional headquarter had enormous implications for the water and sanitation situation. Most of military activities were water-intensive and the thousands of soldiers trooping into the country necessitated the establishment of several military barracks strategically located across the city. The soldiers in the multiple military camps across the city meant increased demand for water, both for their personal use and for their equipment.[295] The Nairobi City Council accused the military personnel of stealing water from the public hydrants,although it was difficult for them to effect any disciplinary action based on the autonomy with which the military operated. In line with this new tension, the municipal chief engineer estimated that consumption of municipal water by the military was about 350,000 g/d.[296] The provision of additional water into the municipals mains to meet this demand from the existing sources presented insuperable difficulties owing to the lack of necessary materials like greater capacity pipes. This was as a result of the global war that made it difficult to secure funds and get fast shipment of the materials.

[295]Ibid.

[296] KNA, Nairobi Water Supply, RN/6/38, 1939–1946.

Boreholes became the only viable option of augmenting the supplies to the barracks for their day-to-day domestic and sanitary demands. However, borehole drilling equipment was equally required. The military,not being in a position that would allow them directly procure this equipment, requested that the Water Department through the local firms to facilitate it.

The increased requirements of military forces led to the creation of the East African War Supplies Board, under the chairmanship of Sir Philip Mitchell.[297] This was divided into two: materials and foodstuffs. On the military side, the Army Supplies Commission was set up. Progress on the various schemes for the investigation and development of water supplies was seriously affected by the shortage of technical staff. Despite this impediment, progress was made on several fronts.

Borehole drilling was not only a preserve of the military institutions but also private enterprises and public institutions like schools. The borehole pumping plant at the Prince of Wales School (currently Nairobi School) had the capacity to revamp the mains supply system as it was harnessed beyond the school's daily consumption levels. However, the municipal engineer in a letter dated 11th February 1941 noted with much regret that the plant had broken down on several occasions. He wrote to the military commander for Nairobi area to offer expert assistance as its sustained functioning meant a reduced strain on the supply for civilian and military populations in the city[298]. The most pertinent observation to make here is that the mushrooming of boreholes as key modes of supply was possible due to the presence of trained personnel amongst the military ranks and, at the same time, the ease with which military orders were handled during the war period.

In a meeting on 8th June 1942, it was further observed by the municipal authorities that during the dry season, the supply from Ruiru could only be used to half its capacity until a time when a dam could be put on the river. With a view to overcoming the difficulties anticipated during the dry season, the military authorities were advised to equip their borehole at Kabete so as to obtain a maximum discharge, of which it would

[297] Colony and Protectorate of Kenya, 1940 Report, accessed at SOAS.

[298] Ibid.

be possible to distribute to all their encampments. The borehole's capacity was approximated to be about 70,000 g/d, with a consumption of only 10,000 g/d at the Kabete camp. It meant that the borehole had the potential to supply the other military bases across the city to enable them to be cutoff from the town's supply. Plans were made to drill a second borehole at the Kabete site, with the aim of moving all troops encamped in Nairobi to Kabete. As for the areas in and around the Nairobi City Park, a borehole was to be drilled in the park to augment the supply. Through the Gailey and Roberts Company in England, the council placed the order for equipment for the above-envisioned projects as special military orders for them to be expedited. There was real urgency to nip the imminent water crisis in the bud before it escalated to unmanageable levels or into a sanitary disaster. Unlike in Uganda, where the war period (1939-1945) witnessed no investment in water and sanitation infrastructure for Kampala, Nairobi's needs sky rocketed in the war period, demanding more investment and alternative approaches.[299]

However, it is also important to note that as much as the government and municipal authorities saw the harnessing of ground water through the sinking of boreholes as a panacea to the acute shortage, the laws appertaining to this activity were tightened. The Works Committee of the City Council resolved that further by-laws be made under Section 69 (26) g of the Local Government (Municipalities) Ordinance,[300] amending the regulations for the supply and distribution of water, and an application was made for Section 54 of the Ordinance to be amended to make it compulsory for persons seeking to sink boreholes or wells to make applications to the Council before proceeding with such works, whether on private or public property. It was through this that the Council regulated and controlled not only the supply but also the consumption of water.

The water crisis seemed to have concerned every city dweller. There were joint efforts made for the adoption of viable measures to alleviate the problem. A John Neale wrote a letter to the then mayor of Nairobi proposing the adoption of 'a special fitting' that

[299]Nilsson (2006)

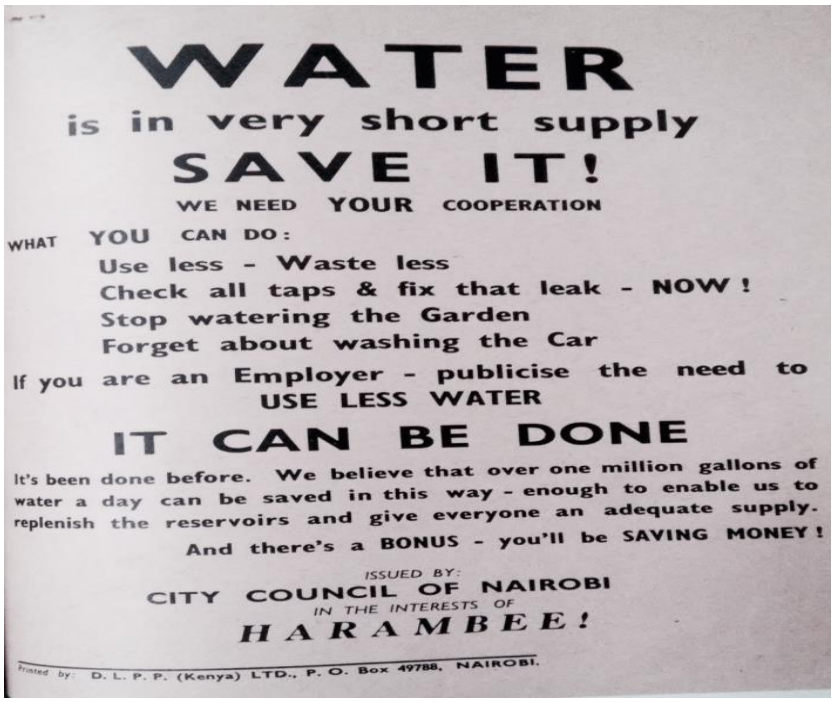
[300] The colonial government governed through several laws passed either in the Legislative Council (Legco) that was predominantly white or by the City Council passing its own laws (by-laws) that were the basis of all jurisdictions except for the Governor who could pass decrees.

would be attached to the taps to save water.[301] The Municipal Engineer reported that he was considering the proposal by obtaining the design of the fitting. This is a case example of how users tinker with technologies, especially in times of crisis. Innovation becomes an ongoing process that did not necessarily derive from above. Users appropriate *things* and in their daily interaction with them, make adjustments or improvisations, or hybridize the systems, especially where scarcity was not only imminent, as in Nairobi at the time, but also where it is part of the daily life pattern. If we were to align ourselves to the old school that 'necessity is the mother of invention', we would argue that such tampering with the system holds greater potential for the sustainability of technologies, as witnessed in this case.

One of the civic leaders further proposed experimentation with rationing, where water would be cut off from residential areas at certain hours of the day. However, the engineer in charge advised against this measure, citing the satisfactory response on the part of the military authorities and the general public to the Council's pleas for water conservation. Aggressive public awareness campaigns had been widely carried out, urging Nairobi residents to adopt water conservation measures. These included newspaper campaigns, public pronouncements at administrative meetings and posters. As the following poster (see next page) shows, behavioural change in relation to water use was envisioned as rewarding in terms of reduced cost at a personal level. However, the scrutiny of the message as captured on the posters shows despair and distress in a city reeling from an alarming water scarcity. The contrast is that water and water use carries with it strong imageries of culture – for example, denoting cleanliness in a pious sense – social class amongst others. Hence, the question that lingers is how effective a behavioural change that entailed firm messages like 'stop washing your car' was in terms of dealing with a perpetual risk of water paucity.

[301] Municipal Council of Nairobi. Minutes of meeting of 30 June 1944. Vol. X.I

Image 10: One of the posters used in the sensitization campaigns for water saving



Source: Nairobi City Council Records (minutes of 30 June 1944. Vol.XI),Macmillan Library

Harambee, as seen in this poster, is a corrupted indigenous word used to imply 'the spirit of co-operation and togetherness', especially towards accomplishing a certain task that involves 'pooling together', a joint effort.

Several proposals were floated on how to minimise wastage of water and maximize on the available supply. Top of the agenda was water rationing. But as one would expect, the policy for controlling consumption targeted the African settlements, otherwise referred to as 'Native Settlements'. Public showers in the African Native Settlements were closed down to minimise 'wastage'.[302] The Municipal Engineer launched a proposal to construct a 'settling tank' and a pump house for the purpose of utilising the effluentthat was at that time running to wastefrom the railway locomotive sheds at the cleansing station. This proposal was approved, with it being estimated that approximately eight thousand gallons of water from the public mains would be saved for the use of the public.[303]

However, the most comprehensive campaign carried out that seemed to pay dividend in saving water was the 'public propaganda' aimed at behavioural change in the way users utilised water. Instilling a sense of responsibility amongst individuals irrespective of

[302]Municipal Council of Nairobi. Minutes of meeting of 30 June 1945.

[303] NCC 1944 Annual Report.

race proved to be more effective. As the poor altered their bathing patterns and quantity of water used, the affluent European community avoided watering their flower gardens. This success saw the municipal engineer decline to use water rationing as an approach, stating that the willingness to responsibly save water had been witnessed. In addition, with the revamped supplies from the military boreholes and the Ondiri swamp project (a project that was instituted to harness more water in the Kikuyu area to supplement the Kikuyu Springs), the position had improved to a degree that made rationing unwarranted.

Furthermore, the Municipal Engineer stated that storage tanks had been provided at the military camps and that a reduction in the consumption of water at the camps amounting to 408,000 gallons had been effectedin January 1944 compared to the previous months. Detailed plans for the proposed extensions to the sewage disposal works at Eastleigh were submitted in a memorandum on the matter, the extensions being estimated to be adequate to deal with the dry weather flow to the site for five years, by which time it would be necessary to construct other works dealing with other sewage zones.

In 1945, F. E. Kanthack, a consulting engineer andmember of the British Institute of Civil Engineers (ICE), released his extensive report on the augmentation of water supply for the Nairobi municipal area.[304] Kanthack noted that the potable water available as in 1945 from all sources (the Kikuyu swamp, the Ondiri swamp, boreholes and from the Ruiru River, amounting to two million gallons per day) was quite inadequate. Population estimates were put at about 10,000 Europeans, 30,000 Indians and 60,000 Africans.[305] In the twenty years that followed, the total population was put at 250,000 people within the municipal boundaries of 35 square miles. Despite the municipal authorities having acquired the water management from the Railway Corporation in the 1920s, it was interesting to see them not being factored into the water demand scape in the expectation that they would undertake their own schemes.

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[304]Kanthack, F.E., 1945, *Report on Augmentation of Water Supply for Nairobi Municipal Area*, Government Printer, Nairobi. KNA Ref. No. K 333.91 KAN.

[305]Ibid.

In terms of sewerage, the report alarmingly observed that it was only the commercial and administrative portions of the town that were provided with a waterborne sewage system. The disposal works on the Nairobi River near the south-eastern end of the town had been designed to deal with 600,000 gallons per day, but it was actually dealing with 900,000 gallons per day, the effluent being discharged into the Nairobi River being consequently very bad.[306] The part of the city that had sewer works was on a combined system.

Deliberations on future supply for water revolved around such suggestions as an equal or uniform quota supply system. However, the expert opinion observed that uniformity, or what I would call a universalized system of supply, would be unnecessarily lavish in the case of the African populationand, to a lesser extent, the Indian population. Traditional habits, general modes of lifeand the fact that much of the water used by Africans was in communal washhouses and latrines, amongst other uses, all tended to lower the *per capita* rate of consumption.

While it is important to acknowledge how infrastructure systems are shaped by socio-cultural practices and that they should never be isolated or divorced from their real political contexts, if as artefacts they are to be understood for what they encapsulate, justifying a variegated supply on racial lines camouflaged by cultural complexity helped institutionalize inequality. This is no surprise as the launching of LTS in the Global North has been observed to have been deployed and rationalized the same way. For instance, Melosi draws a parallel between how the water and sanitary systems were replicated in the US from Europe. He acknowledges that the resulting American systems were not carbon copies of English models, but adaptations modified by local and national cultural, economic, technological, environmental and political factors.[307] However, he notes in equal measure that until the political system was pressured to encourage public participation, local governments catered for the 'better sort'.[308] Despite, the spirit of reform that informed the war period, the system of infrastructural provision for water and sanitation maybe for reasons inherent in itself as a model

[306]Ibid.

[307]Melosi(2000), p. 5.

[308]Ibid, p.13.

continued to be skewed towards a minority group pushed by economic rather than any other considerations. Even in the face of scarcity, needs were met separately.

As the curtain came down on the Second World War, the municipal council of Nairobi continued to receive more and more applications for a water supply and licenses for sinking boreholes. Going by the various minutes of the city council, deliberations centred on the economic value of such connections, the ability and readiness of applicant to incur the cost of connection and the reliability of the sources to necessitate such connections. With several reforms in native housing, the water demand remained high. Despite the attempt to raise the living standards for natives, the supply of water and sewerage as a costly venture analysed in economic terms remained highly limited. Water supply remained primarily on the basis of communal standpipes rather than individual household connections, and toilets and laundry points were supplied on a shared basis. The post-WWII period would be characterized by increased political agitation and far-reaching social economic reforms.

As the shortage of water bit deep into 1945, attention was drawn to the great hardship suffered by the inhabitants of Kibra – an area that had been earmarked as a problem based on its squalor characteristics and one that had become a pain to the colonial administrators for several illegal activities associated with informality, including brewing of Nubian gin (local liquor) – on account of the extreme shortage of water. It was noted that, at the time, the population of Kibra consisted of 97 men, 392 women and 644 children, the small number of men being accounted for the very large male population of Kibra being on active service.[309] Following this dire situation in Kibra, the municipal authorities agreed to arrange with the government for a temporary measure of sale of water to Kibra inhabitants at a standpipe that was already in existence near the settlement. This would be re-considered annually. As the 'Kibera problem' escalated, the government had on several occasions pleaded with the city authorities to expand their boundary to cover the area that was Kibera, but to no avail.

[309] NCC Annual Report 1944/45.

The Municipal Council of Nairobi clearly stated that they did not want to inherit the problem.[310] This reluctance is what informed their position for reviewing the supply of this water supply. In places like Kibera, already demonised and cited for all the wrong reasons, nobody discussed the question of sanitation despite regular crackdowns on butchers and eateries by the public health officer. However, several studies that had been conducted in the 1920s concluded that the soil was not tenable for pit latrines; hence, the use of buckets had been recommended. The problem with this approach was the question of who was to take responsibility for emptying the buckets (KNA). In divorcing these narratives from the above that serve to bracket all local means of provisioning and negate the lifestyles of non-European communities, through employing oral sources of history, places like Kibera assert themselves strongly as thriving with multiple means of supply.

4.5. Diversity and Flexibility in Provisioning: Operating on the Fringes

As earlier stated, much as Nairobi had been planned and developed as a 'whites only' city, the reality on the ground was different. Through natural migratory processes and the presence of non-native immigrant communities, several settlements sprouted up around the city. The oldest settlements for Africans, including Kibera, Panganiand Mathare, had one thing in common; they all lay near either the Nairobi River or its tributaries. This ensured a steady supply of water for domestic purposes. As narrated by Abdallah Omar (not his real name), born and raised in Kibera in the late 1930s, Kibra (as referred to in his Nubian language) was a forested and expansive area that saw both human and wildlife interact in utilising the available resources that included the river. Water from the River Kortumbro (perhaps one of the tributaries leading into the main Mutoini River that cuts across the settlement) was reliable and flowed all year round. The river was a major supply for domestic use.[311] The intervieweein his younger days recounts how they would either fetch the water using simple wheelbarrows or *debe* (a metallic container mostly for cooking oil or petrol, cleaned and used for this purpose). Washing would mostly be done at the river and young boys would plunge into the river for a bathafter cleaning their clothes, a routine they did every Thursdays after their Islamic Madrassa classes. According to the source, tapped

[310] Akallah (2012) (unpublished MA thesis).

[311] Oral interview on 3 August 2016, Lomle, Kibera, Nairobi.

water supply was only a technology preserved for the white settlers and European colonial officers. But the locals would specifically map out tapped water as safe for drinking and use both formal means of acquiring it for that purpose through purchasing it or, informally, by sneaking into the compounds of their white employers to steal such water.[312]

In many occasions resulting from the governance structure, the colonial state in Nairobi had public taps at certain strategic positions, mostly at the administrative offices of either the District Commissioner or District officer. Within the proximity of Kibra settlement that lay on the fringes of the official city municipal boundary, there were three basic public taps that the residents would buy water mostly for domestic purposes. A debe was sold at 20 cents according to the source. One tap was strategically located at the District Officers' centre. Another one was located near Kibra Primary School, at what was called 'Kambi Kitchen'. This was the county of Nairobi's superintendent's office. The Sarangómbe and Lomle residents got water from the tap at the railway station. The women who worked in the houses of the Europeans illegally facilitated another supply system. They would allow others to sneak in and steal water without their bosses noticing. The Nubian community that inhabits Kibera is predominantly Muslim andwater carries religious functions. As such, several wells existed within Kibera, with the source provided an estimated figure of eight of these. One he remembers was near what is the Presbyterian Church of East Africa (PCEA) church ground today, and it served as a provision for ground water.

Rainwater harvesting was also key as a means of supply. Every house had roof-gutters for collecting water in large metallic drums. It was used for general household activities, including drinking. All of this water was considered safe. Perhaps for Kibera, the greatest threat to pollution of the river was the slaughterhouse or abattoir at Dagoretti, but the Sanitary Officer's intervention had ensured that effluent was managed before being released into Mutoini River that traversed Kibera, joining the Nairobi River. The only notable concern of the residents with the water was its fluoride content, which led to tainting of teeth. This they were aware of and it made the tap water supplied at the alternative points favourable for drinking.

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[312]Ibid.

The water business also thrived with the introduction of motorised transport in Nairobi. Small trucks would get water either from Kambi Kitchen or the District Commissioners site and sell it at an increased cost of 30 cents per debe to minimise the walking distance by the residents.

As for sanitation, every household had a pit latrine. As an expansive area in the 1920s through to the period leading to independence, the pit latrine was dug a distance far from the family house for hygiene purposes and minimise foul smell. Once it was full, it was covered and another one dug. The issue of exhausting or emptying the pits would come later with congestion. In revealing an interesting part of how society understands itself and employs knowledge or technologies that answer to their livelihood practices, the people in Kibera knew well that they relied on the river and wells for their own survival. As such, they were aware of the danger posed by pit latrines resulting from the seepage of human waste into the water streams. They, therefore, poured paraffin into the pit and whenever the smell of paraffin was detected in the water from a certain well, they would know that there was contamination and such a well would be abandoned, or at least not used for domestic water purposes.

Nubians were also known for their brewing of a local powerful spirit or indigenous liquor, otherwise referred to in official quarters as the 'Nubian gin'. This required a lot of water for the process and river water became ideal for the process. It was prepared onsite along the river as it used a lot of water in both the manufacturing and condensation process to distilthe gin. This liquor industry thrived after the disbandment of all traditional African brews through the native Liquor Ordinance of 1921.[313] The reason was that the Nubians as immigrants were not categorised as natives and that Kibera had been earmarked as a military camp: security officers were not allowed to carry out their operations within military designated areas.

The same story goes for Mathare settlement, which was equally divided by the Mathare River. The settlement was along the river perhaps earmarking the river as the main source of water. Standpipes, vending and the Nairobi River served as the African areas of Pangani as they lay within close proximity. Despite this differentiated system of

[313]See Ambler (1991).

access, it is important to note that the ability to pay for water basically determined who enjoyed the city supply system. The post-World War II period witnessed a crackdown on what were identified as slums. The government adopted 'slum eradication' programmes, some of whichincluded formalising certain areas through planned housing schemes, for example, in Kibra. However, certain complexities and political considerations saw some informal areas thrive and grow in size as the evictees from elsewhere moved into areas like Kibera and Mathare, where they secured cheap housing.[314] How would this inform the modalities of provisioning for water and sanitation? Away from the official characterization of such settlements as defunct of meaningful living, what potential in terms of the technologies of supply and provisioning lay within these peripheral areas?

4.6 Agitation and Representation: Looking Beyond the Second World War and Retracted Efforts Towards City Provision

The end of the Second World War ushered in a reformatory approach towards understanding urban spaces. The war had drawn in many Africans from the interior into the city as technicians, clerksand informal workers. A small group of government workers of African descent was also slowly growing. The war veterans who had fought on the Allied side were also claiming their stake and political agitation was in top gear. The Native Settlements Committee had discussed and put into effect several plans for African housing through the NCC during the war. Though these housing projects remained inferior to the European and Asian housing plans, water provision and sanitation were paramount to their provision. This had a direct impact on water demand for the city.

A proposal for constructing a dam on Nairobi River had been tendered by the chief engineer of the Kenya and Uganda Railways and Harbours.[315]The municipal engineer submitted the plan from the railway administration showing the site of the dam as inspected by the railways engineer. After the approval of the plan, the site received strong objections from the 'natives' and, as a result, the government settled on an alternative site further into the land that housed St. Austin's Mission Station, which

[314]Obudhoand Aduwo (1992); see also Akallah (2012)(unpublished MA thesis).

[315] NCC, Minutes 1953-1954.Vol.XXI

involved the realignment of the Council's road scheme. The work commenced and in 1946, the Nairobi Dam was completed. It was laid on Mutoini River, which traverses the expansive Kibera, and it helped meet the high demand for water of the military personnel.

While a major effort was put towards the provision of water infrastructure, little attention seems to have been paid to sanitation – a tradition that the city would continue to grapple with for a long time in the post-colony period. The Nairobi River took a toll from the sewage discharges. In 1945, the senior medical officer of health stressed the danger arising from the increasing discharge of sewage and sullage water. He urged the necessity of adequate treatment of sewage before its discharge into the river. The Nairobi City Health Committee noted this and emphasized the need for town planning and the extension of a seweragescheme, which had to precede the development of the undeveloped or unplanned areas of the municipality. Several areas were marked for connection to the mains sewer, including Pangani, Eastleigh Section III, Race Courseand the Fairview area.

The City Council Works Committee noted the continued delay in the preparation and execution of comprehensive plans of water supply and an efficient sewerage system that was adequate to meet the existing and future needs of the municipality. As a result, it was resolved that the council secure the services of an engineer to look at additional sources of water supply, that the it obtain the services of a consulting engineer from South Africato carry out a survey and prepare a comprehensive plan for the drainage and sewerage services of the municipality. It is important to acknowledge the realization that capacity building and expanding the team of experts was key to achieving fast development in the water and sanitation sector of the growing city. The Councilfurther recommended that its Engineering Department be immediately strengthened by the appointment of an additional qualified engineer so that accelerated progress could be made, with many public health works already approved or in progress of being planned. The 'bucket system' had been in use to handle the faecal matter.

The Cleansing Superintendent stated that the 'double bucket' system had been introduced and extended to include some parts of the city (Hill area), with a total of 516

buckets being attended to under the new system.[316] The 'single bucket system' had been in operation in most areas for quite along time, but, as noted by Nilsson from his study of Kampala, Uganda, it was troublesome. Not only was it labour-consuming and a nuisance to the inhabitants, it was also deemed unsanitary in itself.[317] The buckets could not easily be cleaned after emptying, and the emptying also resulted in 'continuous fouling of the ground and surface drains' as well as of the collection carts. But much as 'the double bucket system' came in as a way of alleviating the challenges presented by the old system of handling faecal and sullage matter, the scarcity of receptors used on this system made it difficult to attain the envisaged goals. Its importation and cost resulted in serious delays that prompted the officials to think beyond the system to improve water-based methods of sanitation management. Expanding the trunk sewer system became inevitable.

In 1950, Nairobi, through a Royal Charter, officially received city status (see image 11).[318]Apart from the administrative ramifications that came with this raised status, this elevation in essence meantthe increased ability of the NCC to independently negotiate for funding through grants and loans from international agencies. In 1951, the City Engineer submitted plans and estimates in the sum of £1,935 for the construction of a branch sewer to serve area off White-House Road. Under the provisions of the Municipalities Ordinance Cap.136, the cost of laying the sewer would be recovered from the plot owners. Just like the water crisis, sanitation for Nairobi was becoming a serious challenge that not only required new investments but also faced emerging worries on its sustainability.

There was a serious concern over damage to the existing sanitary facilities in most parts of the city. The city engineer reported damage to flushing cisterns and lavatory pans which was extensive and, thus, it was unwise to persist with the installation of individual cisterns and W. C. suites Tipping buckets had proved unsatisfactory and he recommended the fixing of flushing cisterns with continuous troughs. Amplifying the high degree of destruction targeting public amenities, the City Engineer further

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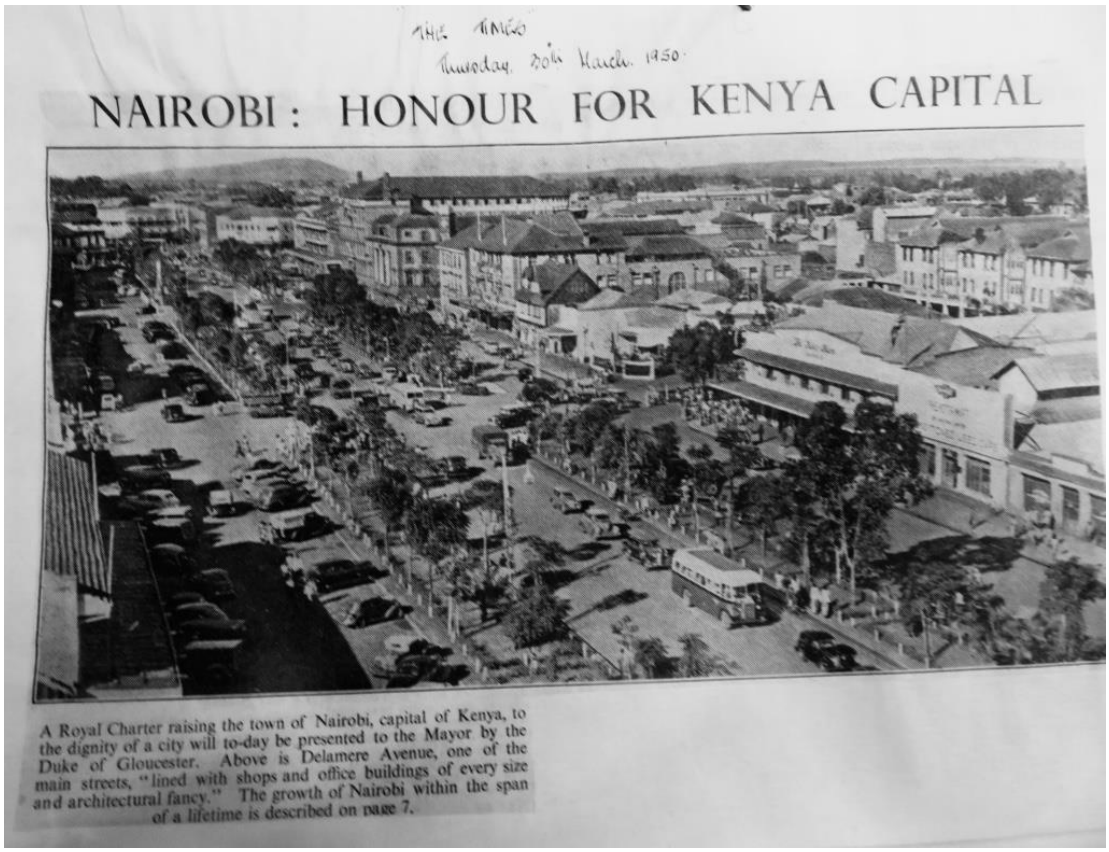
[316] Municipal Council of Nairobi, minutes of the meeting on 30 June 1945, Macmillan Library.

[317] Nilsson (2006).

[318] The Times newspaper, Thursday 30 March, 1950, UK.

Image 11: Image from the Times Newspaper, Thursday 30thMarch, 1950



THE TIMES
Thursday, 30th March, 1950

NAIROBI: HONOUR FOR KENYA CAPITAL

A Royal Charter raising the town of Nairobi, capital of Kenya, to the dignity of a city will to-day be presented to the Mayor by the Duke of Gloucester. Above is Delamere Avenue, one of the main streets, "lined with shops and office buildings of every size and architectural fancy." The growth of Nairobi within the span of a lifetime is described on page 7.

Source: British National Archives, Kew, London. Ref. No. HO 45/24313.

recommended that all bucket type latrine blocks not subject to undue damage or theft should remain and that the 30 flush type blocks. with the exclusion of some areas (for example Gorofani)[319] be converted to automatic flushing with trough-like outlets.[320]

In late 1955, plans to expedite the Ngong Valley trunk sewer were underway alongside efforts by the Director of Public Works to connect to the City Council mains. Several projects were undertaken in various sections of the city to harmonise sanitation systems and, many times, expansion efforts were met by strong objections from individual landowners who were to be affected by the new outlays. The development of 1957/1958 witnessed massive works with huge financial commitments and, as works got underway, circumventing objections raised was of primary concern. In one of the meetings, the Town Clerk reported that provisional apportionment notices in respect to the cost of constructing the Eastleigh Foul Sewerage Scheme, Phase IV had been served

[319]It was impractical to convert the latrines in Gorofani to trough type based on the original designs.

[320] NCC minutes of 1951-52, Macmillan Library, Nairobi.

to the concerned plot owners and that two objections had been received. It was resolved that the objections be not upheld and that the work of constructing this sewer should proceed. In the Parklands Foul sewerage Scheme Phase I, two objections were also raised. Pratap Road project saw four objections while the Pangani Foul Sewerage Scheme Phase III witnessed sixty objections.[321] The authorities, in total disregard of these objections, sanctioned the projects to proceed, demonstrating indifference to the dissent from the affected parties in the expansionist programmes of the large technical sanitation systems in Nairobi. Despite the clamour for political change in the colony in the post 1945 era, these development projects continued to be skewed towards the middle-income (Asian) zones of Nairobi. African native settlements, as they were derogatively known, continued to receive piece-meal low technology developments, with the main aim being improvement of latrine designs rather than installing flush systems. The poor water supply to these areas meant poor water-borne sanitation approaches.

As these new technologies were introduced and implanted from the Global North and replicated within a colonial context, they seem to have encountered challenges in their use and maintenance, which required regular adaptation, localizationand re-examination to sustain them as viable ventures within the city's sanitation branch. The indigenes were accused of vandalism, but theirs could have been a case of construing the apparent destruction as a mode of resistance. To the coloniser, it was a case of developing an efficient network of handling sewerage and best practice for sewage disposal. For the colonised, especially arising from the nationalist protests of post-WWII, these new developments could have been seen as a pure reminder of the more than four decades of cultural imperialism and servitude. Tools and objects of Western origin not only represented westernisation (deculturalisation), but also were in themselves instruments for racial segregation as they connoted 'superiority' in terms of social economic organization.

The 1950s saw other major projects begin as the city grew both in population and physical size. The events of the 1940s had overstretched the inadequate water and sanitation infrastructure of the fast growing city. Consequently, city planners and

[321] NCC minutes of 1956-57, Macmillan Library, Nairobi.

administrators had to think beyond the constrained water and sanitation resources within Nairobi and along its immediate periphery (Kikuyu Springs and Kabete Works), which had sustained it for quite a long time. As Monstadt points out, innovations have enabled cities to extend their ecological hinterlands by importing natural resources or resource-based infrastructure from afar and, also, by using ecosystems far beyond the urban bioregion, as sinks for their emissions.[322] Despite the seemingly parasitic relationship that perpetuated this system of ingestion and egestion of water resources, sources and sites more than forty miles away became a reality rather than an illusion in augmenting Nairobi's water sources. Sasamua Dam, located on the Sasamua stream, a tributary of the Chania River, near Njabini on the South of the Aberdare Mountains, was adopted. Initially a 33.5-metre high rolled earth dam was constructed and brought into operation in 1956.

During the construction of the dam, a small concrete gravity weir was built on the Chania River and river flows of between 0.14 and 8.21 m^3/sec were diverted via a short aqueduct to the Sasamua stream about five kilometres upstream of the dam (NCC 1996). The construction of this dam saw water being pumped 40 miles to Nairobi at its completion and commissioning. Apart from major works on Sasamua Dam, several institutions and individuals applied to the city authorities seeking permission to sink boreholes. These applications were discussed by the Works Committee of the City Council of Nairobi as the law demanded. While many were approved, they were under very stringent conditions, especially in terms of use. An application for agricultural use was to remain solely that, with all other uses criminalised under the license issued. Trunk sewers were also extended in major middle income residential areas that were inhabited to a large extent by people of Asian origin. The African housing projects of Ziwani, Mbotela, Kaloleniand Ofafa, amongst others (done in the forties and fifties), had been provided with basic sewer connectivity supervised by the government as model housing for natives.

By 1959, the Nairobi City Council was gazetted as the sole Water Undertaker under the provisions of the Water Ordinance (No.56) of 1951 and the Water (Undertakers) Ordinance of 1953. This monopoly of water management was informed by the need to

[322] Monstadt(2009).

have a strong centralized system of provision. Within the same period, the Ministry of Health and Local Government proposed amendments to the Water (General) Rules of 1953 to lay down standards to be observed by sewerage disposal works operators with regard to the quality of effluent produced. Surprisingly, these proposed standards were higher than those of the United Kingdom despite the glaring gap between the technical and economic capacity of the two countries. The adoption of these proposals would have serious financial implications on all local authorities in the colony. Nairobi City Council had been given up to the 7th July 1958 to object after which the proposals would take effect. The clerk wrote back to the ministry strongly objecting. The existing sewer system was reported by the city engineer to be overstretched beyond capacity. It was inadequate and overflowed even in dry weather andplans to replace it were made at an estimated cost of £76,400.[323]

The 1960/61 Nairobi City Council budget for infrastructural development had two major elements: improving the existing already over-stretched systems and expanding the network, especially to the middle income areas of Parklands, Pangani, and Eastleigh. Works to improve the layout of Eastleigh Sewage Disposal Works were to commence after the finance committee's approval. The question of Nairobi's future water supplies was of greater concern at the onset of the 1960s as the country underwent a political transitionwhich would mark the end of direct British domination in Kenya. The initial plan was to secure a huge loan (£9,500,000) from the Colonial Development Corporation (CDC). The CDC was hesitant to grant this kind of loan and, as such, the city undertook to seek loan money from the International Development Authority by applying through the Kenya Government and the Colonial Office.[324] The period to 1963 witnessed major trunk lines in Nairobi being not only expanded in terms of network coverage but also boosted in terms of capacity of flow and carriage by replacing the narrow lines with broader diameter mains.

As curtains came down on European colonialism in Africa and, specifically, British colonialism in Kenya, it is important to note that this marked the beginning of a new era in planning for infrastructure. The era of the direct influence of Europeans on the

[323] NCC minutes of 1958-59, Macmillan Library, Nairobi.

[324] NCC minutes of 1960-61, Macmillan Library, Nairobi.

physical and social character of infrastructural systems through policies made in the colonies and effected through legislation would be replaced by a new era of domination through finance agencies like the CDC and the International Development Authority.

4.7 Chapter Conclusion

The use of LTS as a dominant paradigm in the attempt to understand how technologies function within societies especially in urban spaces is greatly limited. Alternative models have been suggested, but the specificities of the process of appropriation call for more inclusive approaches. Nairobi's gradual growth from a railway outpost to the regional commercial and the military headquarters of the WWII period offers a lot of understanding of the role of technologies and technologyuse. The administrative and political shifts fromprotectorate to colony were instrumental in locating the dynamism embedded in infrastructure systems as political entities. The first two decades of the inception of the British colonial rule in Kenya is argued to have seen a socially fragmented space, guided by what was believed to be a system of securing public health. Infrastructural expansion centrifugally progressed either from the railway quarters or the CBD, where the colonial authority had pitched tent. But the colonial status from 1920 marked an era of increased tensions along racial lines, fuelled by the settler and Indian question. The stage waslaid and it is within this period of rife racial suspicion that Nairobi's water and sanitation system witnessed expansive growth, enhanced by its monopoly and the initial concrete efforts made at urban planning at the time. Inspired by LTS thinking and the reproduction of the 'network city' ideal, centralized administrative structures and the management of technical artefacts of water and sanitation provision were believed to solve major urban challenges; yet, within the colonial context of most Global South cities, the irony of implementation and adoption of LTSs is the social differentiation.

Using the example of the Indian bazaar, Murunga indicates that the attempt to institute white supremacy in Nairobi failed as a result of several factors, on top of which was the cosmopolitan nature of the bazaar and perhaps the political agitation of the 1920s. Either way, business-inclined settlers demanded a system of town planning that was class based rather than racially divided.[325] As Njohnotes, the colonial urban designers

[325] Murunga (2012).

were not subtle in advocating for racial residential segregation[326] and building codes were defined clearly based on the European standards of housing and living. This means that European working class people in the colonies were also excluded from such areas. Eastleigh legally remained 'Indians only' settlement but in reality housed the highly competitive Somalis, Asiatic communities, as well as European middleclass settlers. The colonial enterpriseto differentiate society, therefore, did not achieve much as settlement patterns were determined by a plethora of factors. This instead reproduced either a collage landscape or several urban mosaics that remained distinct both in character and in terms of the technologies of procuring water and sanitation services. Off-grid locations like Kibera exhibited highly hybridized mechanisms of provisioning. As users, the residents of Nairobi maintained their dynamism, creativityand flexibility as they interacted with bottom-up approaches to supply, as well as conservative European 'modernist' ideals of provisioning, planning and urban morphology. It is this complementary stature that must be seen as representing the character of Global South cities. Both state or large organizations' efforts and the 'do it yourself' or bottom-linked approaches must be seen as operating alongside each other as a means of adopting, adapting, improvising, hybridizingand generally appropriating modalities of provision as reproduced at the interfaces of the old and the new, the indigene and modernist, or the local and 'migrant' technology.

By operating on shoestring budgets, colonial authorities concentrated infrastructural development in the white-dominated areas as a way of enhancing 'European good lifestyles'. Except for government institutions, individuals had to apply for connectivity, but the cost of connection from the mains remained solely on the interested client. The 'willing seller willing buyer' approach, though not the main consideration throughout, meant that the socio-economic environment was a key determinant in the production of spatially dichotomized cities. Infrastructures acted as reinforcers of this division in an unintended manner but in a consciously racially divided environment. It is their accessibility through a large centralized network that plugs some into the grid and, at the same time,leaves the majority off the grid on economic terms. The infrastructure finance system supported by loans prompted the authorities to develop a cost-recovery component to access and provision. Documents

[326]Njoh (2008).

of application to the Colonial Development Commission (CDC) that funded and endorsed most projects financially were debated on the question of financial soundness in terms of the viability of the loan schemes. Colonies independently existed in terms of raising their own revenue for sustenance. Infrastructural projects undertaken along the popular LTS model must be interpreted as investments lacking universalization as an end goal.

Finally, the over-emphasis on water provision and limited planning for sanitation increased the level of fragmentation. This in itself exposed the nascent city to high levels of pollution of surface water as well as underground sources. The preference to use septic tanks and cesspools amongst the relatively affluent and pit latrines in poor neighbourhoods meant a high level of seepage for a city that instrumentally relied on boreholes to anchor its supply system. The great potential that lay in rainwater harvesting and the failure to capitalize on it remain the most surprising element in planning for Nairobi despite the acute shortage that characterizes the city from its inception. In acknowledging that technologies must be contextually located and analysed as non-passive entities, what prospects would independence and post colonial ideologies hold in terms of water and sanitary systems for Nairobi?

CHAPTER FIVE

INDEPENDENCE, STATE FORMATION AND THE HIGH MODERNIST AGENDA: THE WATER AND SANITATION 'GEOSCAPE' IN POSTCOLONIAL NAIROBI, 1963 TO 1978

5.1 The Dawn of Uhuru and the Trajectory of Independence

In tandem with the over-riding assertion that technological systems lack neutrality and that they are conceived within a contested milieu that sees them emerge as socio-constructs, technological artefacts have to be located right at the core of the socio-economic and political junction that defines a country's economic and political paths. Just as the economics and politics of a state are the flipsides of the same coin, so is technology the ambivalent force that mediates and negotiates the end goal of a political regime's public policy. This in itself is not to bestow enormous determining capabilities to technology, as argued in some of the STS literature. It is merely an acknowledgement of the centrality of technology irrespective of its sophistication and size in aiding society attain their livelihoods within the respective facets that represent the totality of their life. If we are to operate on the premise that colonial policy intertwined with infrastructural provision in a manner that ordered society differently and that users, especially those on the fringes of the large technological systems that were adopted under the cover of promoting civilization, in their day-to-day survival appropriate technology differently, then we must also undertake to analyse the dynamics of technology in infrastructure provision, in this case, water and sanitation, within the realm of the emerging political state, as juxtaposed on the promise of *uhuru* (independence).

To discern the dictates of the state versus its public service provisioning agenda, its foundations have to be unmasked. The nature and character of the political economy have to be discussed alongside the technological agency in provision. After more than four decades of British colonialism, the decolonization process gathered momentum in the post-WWII period.[327] African nationalism was on the rise, pursuing more political rights than the welfare associations of the interwar period that had focused on improved wellbeing and equality. The colonial state in Kenya was politically constituted to serve

[327] Ochieng'(1983).

the minority interests and economically meet the needs of the metropole. Several policies were drafted and even though they were disrupted by global events like World War I (1914 to 1918), the great depression (1929 to 1934), World War II (1939 to 1945) and the post war era,[328] their implementation was further compounded by a series of contradictions with which the colonial state had to cope, rarely with any success.[329] A good example of these contradictions is the clash of interests between the metropolitan capitalists and the colonial state in Kenya.[330] In cases where the local interests seemed to be clashing with those of the metropolitan financial bigwigs and Westminster technocrats, the British merchants and financiers always had their way if not their say. This was no surprise since the colonies were from the beginning designed and engineered to serve the metropole in a parasitic and imperialist economic and political relationship. With a Euro-Christian capitalist work ethic created through European missionary education, the emergent African elites of the post war period served the colonial state and economy as semi-skilled workers, clerksand chiefs.[331]

Though the passing of the Colonial Development and Welfare Act in 1940 and its expansion in 1945 signalled an increased interest by the colonialists to promote the colonies and improve the welfare of the indigenous communities, historians D.A. Low and John Lonsdale equate the post-war period to European conquest and occupation in the late nineteenth century.[332] Their assertion results from the premise of imperial investment after World War II tremendously increasing and seemingly exhibiting 'a second colonial occupation'.[333] This time the justification was that increased investment aimed at bringing efficiency that would raise African production, protect African land from erosion and Africans themselves from disease, would be in search of the democratic support without which no project, however expert, could be implemented.[334] However, this efficiency remained elusive, as it was never an end in itself.[335] Instead, what was institutionalized was a paternalistic system that would ensure continued

[328]Wriggley (1965).

[329] Lonsdale and Berman (1979).

[330]Ndege (2009).

[331] Ibid, p. 7.

[332] Jacobs (2014).

[333] Low and Lonsdale in Low and Smith (eds) (1976).

[334]Ibid.

[335] Jacobs (2014), p.307.

European presence in Kenya even after independence through a neo-colonial economic system. As Mwaura observes, independence was not granted to colonial territories out of a romantic vision of the equality of peoples.[336] It was simply the realization that capitalism in the 20th century no longer required colonialism to serve its purposes and that the political and military costs of maintaining colonialism were both high and unnecessary; there were other, cheaper methods of maintaining economic dominance.[337]

An understanding of the dynamics that informed the emerging independent states is key in providing a basis on which we can attain a relatively instructive and insightful breakdown of the nature of and the technological underpinnings of infrastructure provision in the post-colony, in this case, water and sanitation for Nairobi. The history of technology has already revealed to us that technology is neither neutral nor passively interactive with both human and non-human components of society. Hence, the events that politically and economically characterized Kenya by 1963 must be unpackaged to provide a backdrop against which we can attempt to map out an inclusive history of water and sanitation in terms of technologies of provision, both in their 'soft' and 'hard' forms. How was the new state politically constituted in its urban set-up, specifically Nairobi? What was the inter-play between politics and livelihood provisioning in the nascent state under the first independent regime? What did the 'exit' of the colonial regime imply for Nairobi, especially for the water and sanitary landscape? The gaining of independence carried with it the promise of egalitarianism and a rejuvenated African character away from the colonial patrimonial state.

Though decolonization had sought to ensure that power to self-govern would be passed over to the local community through its brand of political leaders, one can sceptically state that perhaps in retrospect, independence was tacitly granted by the colonialist early enough without ensuring the existence of strong technical manpower base. This would leave the state highly vulnerable torelying on the colonial appendages in form of socio-economic and political legacies in total. How did this shape the character of the state and its political capital, Nairobi?

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[336] Mwaura (2005).

[337] Rodney (1972).

While independence would see Nairobi further established as the political and economic capital of Kenya, the jubilation with which self-rule had been received had to be replaced by planning for critical infrastructure on the principle of egalitarianism. However, the infant state found itself trapped in the Cold War web in terms of governance and socio-economic planning. For nascent states like the Kenya of 1963, this challenge was compounded by the shortage of local expertise to undertake such projects. The system of education employed by Europeans in their colonies had been segregative in nature as it only trained Africans to be artisans and clerks. For a very long time into the independence period, Kenya and specifically the City Council of Nairobi would continue relying on European engineers.

In *Black Skin, White Masks*, Fanon talks of the alienation of the black people as a result of colonial subjugation.[338] However, on a much specific scope, this was an indictment of the crop of leaders and the fast rising petty bourgeoisie that emerged at independence across Africa, with Kenya not being an exception. Independence for Kenya did not mark any purposeful breakaway from the colonial practices of its immediate past. The Nairobi City Council (NCC) witnessed a change of guard in its hierarchy but remained deeply rooted in its past in terms of the way city planning and management were envisioned. The elitist leadership that inherited the reins of power from the colonial state presided over a city spatially segregated by class rather than race, the latter of which in some respects had informed colonial infrastructure planning and spatial appropriation. The leadership that emerged looked more eager to occupy the prestigious spaces left vacant by departing colonialists.

Furthermore, the Cold War scenario that engulfed the post-World War II world witnessed sharp ideological differences in the ruling party based on service provision and general governance. The emergence of two rival camps, ideologically split on how best to approach development issues and deliver on the promise of independence, created an aura of conflict, suspicionand patronage at the national level, which sometimes created inertia at the lower echelons of governance, including the Nairobi City Council (NCC), which managed water and sanitation for Nairobi. With the die cast on the politics of the immediate independence Kenya, as defined by sharp

[338]Fanon (1952).

ideological differences and emergence of a bourgeois political class in an environment heavily loaded with the expectations of the masses, it is necessary to first understand the developmentalist agenda of the government then within the prism of the high modernism debate. Certain infrastructures were highly favoured and popularized foroffering the city and the country at large takeoff alongside the rest of the globe, following the path of the 'celebrated' West.

5.2 The Paradox of Independence and Nairobi Water/Sanitation InfrastructureDevelopment: Positioning Technology and the 'High Modernist' Debate

As highlighted earlier, post-World War II colonial control was marked by a tacit reformist agenda that was repackaged with renewed vigour perhaps to revitalise the reconstruction of ravaged and dilapidated British economy from the devastation of war. For Tischler, British post-war developmentalism was marked by the significantly increased provision of development funds, personneland technical assistance. Retrospectively, this entailed a 'reinvigoration and re-legitimisation of the empire' within the dictates of the Atlantic Charter[339] in the short term and forging stronger 'dependency ties' in the long term.[340] To a greater extent, rather than the colonial arrangement that was directly paternalistic to the colonies, the post-war period ushered in international financial agencies like the International Bank of Reconstruction and Development (IBRD) and the Colonial Development Corporation (CDC) as key players in the process of driving for internationalized development. One of the key achievements of this shift was the detachment of north-south intervention from the colonial networks.[341] In terms of practicability, these new instruments of imperial control restructured the arena through the enormous power mediated through global market forces as a means of stepping into the 'utopic future'.

For the colonial and international modernizers, a technocratic rhetoric in line with their confidence in scientific planning became the clarion call.[342] The so-called 'under-

[339] The Atlantic Charter was a joint declaration released by U.S. President Franklin D. Roosevelt and British Prime Minister Winston Churchill on August 14, 1941, following a meeting of the two heads of state in Newfoundland. The Atlantic Charter provided a broad statement of U.S. and British war aims but key its seemingly contradictory stance on European imperialism across the globe.

[340] See Tischler(2013).

[341] Cooper and Packard (1997).

[342] Tischler (2013).

developed' world had no choice other than to pursue development in all its spheres through scientification and technological leapfrogging. The Tennessee Valley Authority (TVA) became a prototype worth replicating across the upcoming economies in the world.[343]The international consultants, through their paymasters who constituted the international development and financial agencies, doubled their effort in studying the Tennessee model and making recommendations on the potential of other nations to adopt and imitate. While it would be approached with some relativity that factored in the other unique militating factors on the specifics of geopolitical location, the developmentalist agenda centred on large technological projects. This sometimes translated into Dirk van Laak's 'white elephants.'[344]For cities like Nairobi which faced critical water shortages and an embarrassingly inadequate sanitary system, all in the face of a booming population growth and an economy desperate for expansion, huge technological systems of water abstraction within catchment areas miles away through dam constructionwere seen as the most secure for posterity. Solutions to urban and national crisis were believed to derive remedies from without rather than from within despite all the political rhetoric on Africanisation and indigenisation. In the true spirit of the hubris that characterized most of the post-war period for most colonies of the British, scientisation also became manifest in the Colonial Office (CO), where the civil servant who 'knew his natives' was gradually replaced by the technical expert, specialising in particular subject areas, such as health, agriculture or medicine.[345]

However, how many of the indigenes would take up this new tag of expert organiser that was ubiquitously modelled along 'grandeur' scientific thinking as a panacea to the myriad day-to-day livelihood challenges in the race towards international capital homogenization? Schumacher's *Small is Beautiful* (1973) analogy found no resonance with the post Second World War developmental thinking. High modernist ideals with science and the machine that reproduced large projects, be they in water or on land and sanitation infrastructure for urban societies and rural agricultural economies, ruled that policy formulation for most states beengineered and supervised under the auspices of international financiers and multinational corporations headquartered in London, New

[343] see Tignor (2006).

[344] See van Laak (1999).

[345] Cooper (2005)and also Clarke (2007) in Tischler (2013).

York, Brussels and Leningrad, amongst many other industrial and financial capitals of the West. The role played by these institutions as instruments of neo-colonialism was central not only in shaping the character of the emerging states but also in determining their political fabric in a volatile cold war age driven by two contrasting ideologies.

Tischler, in focussing on the enormous Kariba Dam project along the Zambesi River, which pits modern day Zambia and Zimbabwe, vividly paints a clear picture of how development was conceived and technology in its largess granted a deterministic potential to drive emerging economies to unrealized greatness:

> The imperative of development implied that all societies had to break radically with 'tradition' and 'backwardness' in order to enter 'modernity'. If the poorer (i.e. underdeveloped) countries did not successfully adapt, they were doomed to collapse.[346]

In hindsight, Tischler, rather than being a critic of this notion of gigantic pursuits that characterized the post-1945 world, comes across as either a high modernist or a sympathiser of high modernism. In referring to positivists of high modernism, she states that while this dichotomous approach of 'traditionalism' equalling economic doom and 'modernism' being equivalent to development can be dismissed as arrogant and oppressive, it also has empowering effects. Here, development has a 'transitive' meaning, since differences between societies are framed in terms of quantity, not substance, and poorer countries can catch up with a prosperous West, whose experience help accelerate the transition process.[347] As the German-born Australian economist, Heinz Wolfgang Arndt, notes, the idea of development as 'everyman's road to utopia'[348] needs to be set against the cultural essentialism of indirect rule or trusteeship.[349] Cooper and Packard summarize the ambitious, positivist and overt optimism bestowed on the thinking of mid-20th century modernists as follows:

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[346]Ibid. p .23 see also Lewis (1954); Cooper (1996) and Tignor (2006)

[347]Rist (2006) in Tischler (2013)

[348]Arndt (1987).

[349]Tischler (2013).

> One cannot appreciate the power of the development idea without realizing that the possibility that modern life and improved living standards could be open to all, regardless of race or history of colonial subjugation, was in the 1950s a liberating possibility, eagerly seized by many people in the colonies.[350]

By envisioning a sweeping, rational engineering of all aspects of social life in order to improve the human condition,[351]high modernism packaged in large-scale technological projects was expected to deliver predictable results. The 'avant-garde' undertakings represented illusionary progress. The repackaging of the European order and setting the former colonies in a rat race became the undoing for most of the infant states.

For political figures like Lenin, the motivation to construct large technical systems was not only to jumpstart a forward march of history, but also to prevent any backslide by counter-revolutions. [352] Borrowing from Langdon Winner's political debate on technologies,[353] this would imply that political regimes especially of an autocratic kind see certain technologies as operating within specific political milieu for control and stability in governance. But to believe that the 'strong-man' rule that emerged in most former colonies at independence encompassed deliberate decisions to institute certain technologies as political instruments of stability and control would in itself be to over-stretch the imagination. The high modernist ideology to a greater extent stemmed from the West and was anchored in the former global imperialist web. Global South capitals after several years of colonial rational planning failed to disentangle themselves from the global network mired in the exploitation of the periphery and the development agenda of post-independence remained an off shoot of high modernism planning to be run by the West for the West. As such, what would be the technological domino effect for emerging independent cities like Nairobi?

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[350] Cooper and Packard (1997).

[351] Scott (1999).

[352] Williams (1994).

[353] See Winner (1987; 1993).

Borrowing from James Scott's *Seeing like a State* (1998), David Nilsson affirms that in the course of transforming the nineteenth century city, state actors and urban planners reduced complexity by simplifying, as well as standardizing, social and physical structures in order to make them legible and controllable.[354] However, these conscious approaches prescribed by high modernist thinkers and practitioners ignored the multifaceted nature of things. They also ignored the viewthat it is the aspirations manifesting at the interstice of deployment and usage that offer utility to the respective process of appropriating *things* and ideas. Granted powers to order or reorder, technical artefacts are underpinned by political ramifications. What the proponents of modernism through large scale technological endeavours did not realise is that their externalist development agenda, as espoused by under-development and neo-colonialist scholarship, served well as a recipe for exploitation of the periphery by the centre.

In contrast to the expected grand march forward, most of the projects undertaken metamorphosed into 'white elephants' that choked the emerging economies into debt crisis by virtue of the heavy investments factored in through loan agreements. The environment of total disregard for gradual processes of development and the potential for invention and innovation at a small scale served perfectly to alienate the majority of the citizenry in nascent polities like Kenya, which was struggling to shake off the shackles of more than six decades of European colonialism. In its place, it promoted class differentiation as the minority elite accumulated wealth and the masses were further thrown to the periphery on their own means. The envisaged dream of independence either aborted immediately or lacked a local basis it would have thrived on, supported by more bottom-linked technological approaches, especially in the provision of basic services like water and sanitation. Rather than being accommodative, which would have led to an opportunity for hybridity between the 'new' and the 'old' or 'big' and 'small' for these countries with entangled histories, the modernisation rhetoric provided a wrong footing for a society that had been promised egalitarianism and the splendour of self-rule.

Perhaps high modernism failed to acknowledge the multiplicity of actors within a system and unilaterally bequeathed science, as understood in the West, with the

[354] Nilsson (2016).

unquestionable ability to determine the future of society along a predetermined path. High modernism is believed to have implied the rejection of the past as a model to improve upon and a desire to make a completely fresh start. The more utopianthe high modernism, the more thoroughgoing its implied critique of the existing society.[355]In the break from the old, the machine acquired almost an idolised status as a non-human actor in production without paying attention to the nature of the interactive process that is shrouded with cultural and political underpinnings. It is a case of either the machine having been humanised to disregard human agency in the making of history or high modernism ideology having trusted the engineer, technocrat, shrewd business person or autocratic administrator, with the ultimate role of determining the course of history through the planning and implementation of grandiose futuristic plans. By seeing infrastructures and technological artefacts as apolitical, modernist scholarship and implementers of LTSs would see most projects either come to an outright dead end or precipitate a perpetual crisis that engulfed cities like Nairobi.

In the unpacking of the concept of technological determinism and understanding the push factors behind high modernist thinking, Rosalind Williams acknowledges that indeed fate can be engineered and that we should look at those who choose to invest in large, complex technologies, and consider that they may do so quite deliberately in order to create technological determinism.[356] After independence, most states lacked the where withal to chart their own courses. Yet, having undergone more than several decades of colonial domination and cultural imperialism, the indigenous was either rebuked as 'backward' or non-urban. Colonialists deliberately chose to see the indigenes in the city as 'detribalized' communities. While 'detribalized' would have mostly meant an urbanite society that had broken ties with the rural lifestyle, it was tacitly settled on as a means of culturally colonising the Africans to shedtheir own identities and view themselves as 'modern and civilised'.

One of the ardent visionaries of a high modernist city is Le Corbusier. City planning until the 1960s had been dominated by a functionalist approach that mapped out different zones within the city according to their respective functions, for example,

[355] Scott (1998).

[356] Williams (1994).

government offices, entertainment spots, residences and industrial zones. Nairobi, from the 1960s to date has exhibited firm imprints of this functional segregation approach. However, on a global scale, Le Corbusier drew the contrasts between the existing city, which is a product of historical chance, and the city of the future, which would be consciously designed from start to finish following scientific principles.[357] The Le Corbusian high modernist city was designed with strict scientific stipulation of the human needs as a workshop for production. He deplored both the conditions of the slums and people they had created.[358] If high modernism abhorred 'the deplorable' in its futuristic city, then it reinforced the notion of it being basically a utopic pursuit that was so much divorced from the reality of the city, whether North or South. All in all, the emergence of 'rational planning' shaped the nature of most cities in the post-war era. Although, despite the redrawing of master plans in the former colonies, little translated into actual planning as colonial legacies persisted to continue shaping the cities.

The city in itself tailormade within principles of high modernism which are non-accommodative to indigenous means modes of living, yet its creation continues to represent a differential spatial and social systems of centre versus periphery, serviced versus unserviced and planned versus unplanned settlements. As Freund indicates, the dual city in Africa is a widespread phenomenon necessitated by various historical and political factors in the face of European hegemonization.[359] If high modernism and capitalism are bedfellows, then social differentiation is an unavoidable imprint on the city. The pursuit of wealth accumulation by a few thrives on the poor masses for whom the city implies survival for the fittest in Darwinian terms.

The colonialists had granted 'flag independence' to their former colonies but reinforced the patrimonialist system that ensured their eternal presence in the economic and political arena of such states. The 'puppet governments' that emerged in the former colonial capitals continued to be operated like marionettes as global financial and development corporations did the bidding. How did the entry of the Colonial

[357] Scott (1998).

[358] Le Corbusier (1933) in Scott (1998).

[359] See Freund (2007).

Development Bank and IBRD into the water and sanitation sector financing for Nairobi shape the technospace in terms of deployment, access and power relations in the infrastructural domain? Faced with the grandeur that has cost implications, how did the periphery reproduce itself technologically to attain water and sanitation services? What kind of overlaps and intersections can be discerned within the intricate history of technology for most Global South cities like Nairobi? While these are questions from which complex narratives can be anticipated, the history of technology itself is expected to capture every case as unique yet entangled in the larger scope of colonial and postcolonial histories. It becomes imperative to historically interrogate Nairobi in terms of its water and sanitary endeavour as it chased its modernist dream, especially in the first two decades after independence.

In *White Elephants*, Dirk van Laak observes that the development of technologies has always adhered to the delusions of grandeur and greatness that characterises engineering as a whole.[360]He asserts that the development of power plants and citywide electricity networks, as would be the *modus operandi* for all other infrastructuralsystems, are paradigmatic examples of the expansion of 'large technological systems'. Many of them were initially designed to serve only a few downtown office blocks but as soon as demand was awakened, aggressive plans were made for much more grandiose schemes.[361] However, unlike the West, where these schemes ended up being extrapolated to cover and re-engineer what some have referred to as 'a network city', in the Global South, which was reeling from European imperial control, the pattern of development seemed to be determined by economic considerations many times equated to race differentiation, rather than their own nature, through what the father of LTS, Thomas P. Hughes, termed as 'technological momentum'. [362] Large-scale technological systems reshaped city planning as they demanded a long-range vision on the part of municipal officials for population forecasting, technical network design and infrastructural financing.

[360] van Laak (1999).

[361]Ibid.

[362] Hughes(1987).

Despite the high modernist thinking, there are urban planners like Jacobs who see the city as an inclusive space that has the capability of providing something for everybody, only when they are created by everybody.[363] In contrast to the exclusivity that characterizes the high modernist city, counter paradigms as propagated by planners of Jacobs' ilk consciously make room for the unexpected, small, informal, and even non-productive human activities that constitute the vitality of the 'lived city'.[364] Furthermore, despite the attempts by urban planners at designing and stabilizing the city, it escapes their grasp; it is always being reinvented and inflected by its inhabitants.[365] The city as an organic space remains alive to the forces of change and transformation engineered by both its human and non-human components. Colonial baggage dating back to 1899 and the burden of remaking itself into a 'modern' capital faced Nairobi in 1963. With a burgeoning population eager to share in the allure of urbanization and an economy devoid of large investment capital, what was the nature of the water and sanitation infrastructural planning? What was the political climate and how did it shape technological developments in the social provision sector, of which water and sanitation constitute the core?

5.3 Independence, Technology and the Universalization of Water/Sanitation Infrastructure for Nairobi

5.3.1 The Political Landscape: Informing provision

On 12 December 1963, Kenya got political independence from its colonial master, Britain. The struggle for independence and constitutional reforms that had preceded independence had been on the premise of egalitarianism, good governance and great economic growth based on functioning infrastructural systems. The slow but steady reforms necessitated by the lessons and aftermath of the Second World War had seen Nairobi make headway towards improving service provision forthe African-settled areas. The housing schemes established in the late 1940s into the 1950s had only catered for a fraction of the rising number of Africans trudging into the city of Nairobi in search of off-farm employment. Most of the people who settled in the new middleclass residential estates were drawn from the bulk of low and middle cadre colonial employees, who were basically clerks, meter-readersand office messengers.

[363] Scott (1999).

[364] Ibid.

[365] Jacobs (1961) in Scott (1999).

The rest of the African population was located on the fringes of the city, thriving within non-serviced or underserviced spaces. The movement for political independence promised to reverse this reality and redraft the socio-economic landscape of the entire country, Nairobi included. The advent of independence as a result guaranteed people freedom of movement, which spurred a high rate of rural-urban migration.[366]

This post-World War II 'urbanization boom' spelt a different picture for each social group in Nairobi. As the fast rising petty bourgeoisie replaced the departed Europeans in exclusively planned high-end zones, the high number of unskilled or semiskilled people trickling into Nairobi compounded the housing problem. Thiswas directly related to the sanitation and water infrastructure supply as these immigrants occupied what looked like abandoned, unoccupied or less habitable enclaves. The early 1960s were basically transition years, which presented unique challenges, not only to the national leadership but also to the authorities in the capital city, Nairobi. The fact that most of the expertise needed for municipal works was still entirely comprised of former colonial officers of British descent made it difficultto initiate any major shift in city infrastructural planning, management and general governance to capture the ideals of *uhuru,*as promised by the nationalists.

The political climate around the mid-sixtiesbecame highly polarized as those who characterized themselves as socialists became more and more disillusioned. The first president, Jomo Kenyatta, quickly moved in to amend the independence constitution. He established a highly centralized system of governance, away from the constitutionally envisioned federal system that was otherwise referred to locally as the*majimbo*[367] system. Understanding this shift in governance of the new state is critical in attempting to understand the operations of NCC as a major water and sanitation undertaker for Nairobi. Actions of historical magnitude by people, especially those in positions of authority, and outcomes of historical relevance must be interpreted within a broader scope of not only wanting to answer the why and how questions, but also doing it in connection with the outward forces of the time in context. To be able to

[366]Mireri (2005), p.107.

[367]Majimbo is a Swahili word for regionalism. The independence constitution had been a compromise amongst different political groups that recognized autonomy in governance based on regions in certain key areas.

explore the meaning, effectand use of various technologies in providing water and sanitation in post-independence Nairobi, the socio-economic and political profile of the country at large and the city in particular must be unpacked, if only at a glance. Was the consolidation of power by the Kenyatta regime towards an oligarchy a conscious scheme to enhance autocracy that the high modernist goal depended on for achievement? Apart from gaining more control on determining the future path for Nairobi as independent Kenya's capital, the exercise of power informed the debate on the position of providing for the urban underclass. How did the indigene fit in the new city with little disengagement from the colonial practice in city administration?

Kenya was one of the most important Cold War frontiers in East and Central Africa because of its geographic and strategic position. Concomittantly, the governance and economic models through which technologies were conceived were impacted on by the dynamics of the war. The international politics of the Cold War era spilled into the core of Kenya's political structure. It pitted those who seemed to be identified as capitalists and rent-seekers against those who were branded as radicalists-cum-socialists, sympathetic to the USSR. The radicalists led by Jaramogi Oginga Odinga and Bildad Kaggia argued for the government to play a socialist role in service provision by prioritizing the poor. They called for heavy investment in social welfare and general improvement of livelihoods.[368] The president himself had identified disease, povertyand ignorance as the key evils that afflicted the country. Fighting disease and poverty amongst the rising urban population in Nairobi meant adopting all-encompassing approaches to the water and sanitation crisis that had been made complex by the prevailing housing shortage and skewed planning ideals. Yet, the same government that had prioritized combating pestilence continued to exhibit a benign neglect of informal spaces cutting across Nairobi.

Be it as it may, the government responded to the critics of its neo-colonialist and capitalist tendencies by producing a social, economic and political blueprint, *Sessional paper No. 10 of 1965,* titled, *African Socialism and its Application to Planning in Kenya*. [369] In this blueprint waswhat popularly came to be known as the *harambee*

[368] Hornsby (2012), p.93.

[369]GoK('Sessional Paper no. 10 1965: On African Socialism and its Application to Planning in Kenya,' 1965).

philosophy. Harambee was adopted and popularized by the autocratic leadership of the time to 'imply pooling together for development'. Social economic growth was to be realized through joint efforts or partnerships in a semblance of a communitarian system, believed to be embedded deeply in the African social structure. In a wider perspective, this implied self-help as an integral part of provisioning services. While this would be the norm in the informal areas, prompting Hake to characterize Nairobi as a 'Self-help City',[370] the greatest impact in terms of development through the harambee system was recorded in the countryside rather than the cities, which sought to develop along modernist ideals.

5.3.2 A Blueprint for Development and its Implication for Technology

The Kenya blueprint for social, economicand political development, *Sessional Paper No. 10 of 1965*, came on the heels of a very divided political leadership and the waning optimism that had greeted independence two years earlier. The government, through the Ministry of Economic Planning and Development, felt compelled to produce a blueprint or a policystatement that would not only provide a socio-economic road map to prosperity but would re-engineer the greater ideology to define the country's political fabric. The state was entrenching capitalism to an alarming extent, leaving the masses disillusioned and dispossessed, with the promises of *uhuru* also turning into a smokescreen. From the president's statement in the document's preamble, it was clear that Kenya was on a path of attempting to plug its economy into the global arena by seeking new markets and new areas of technical support and trade co-operation in the world. This linked well with the popular modernization rhetoric at the time. The so-called Africanisation of the economy and public service was expected to be clearly spelt out in the document.

However, while it appeared on paper, it was not clearly articulated in attainable goals. Instead, the contradiction was clear as East is to West. All it seemed to imply was the filling of public service positions formerly held by Europeans with an indigenous labor force. The document failed to emphasize and highlight what African socialism and Africanisation meant in terms of bridging the incoming knowledge and the indigenous expertise, especially in terms of technical capabilities in small-scale industrial

[370] Hake (1977).

production and service provision sector. This was despite the acknowledgement in the document that the nation's work force remained largely uneducated, untrained, inexperienced and unrewarded by the growth of the economy.

Much as the general public and the socialist wing of the government expected this blueprint to mark a departure from the stubborn formerly colonial exploitative arrangement and organization of all spheres of life, the document sought to explain the dilemma the country only in terms of development. Compelled by external pressure, it was almost impossible to disengage from the former colonial ties and the need to pursue development as defined and supported by the major powers of the West. It stated:

> Kenya is in a period of multiple transition set in motion by the attainment of independence. We are in transition from a subsistence to a monetary economy, from an economic dependence on agriculture to a more balanced growth, from a development of natural resources for others to a development of human and natural resources for the benefit of the people of Kenya. The progress wanted cannot be easily won and it cannot be achieved by reverting to pre-colonial conditions. The best of Kenya's African social heritage and colonial economic legacy must be re-organized and mobilized for a concerted, carefully planned attack on poverty, disease and the lack of education in order to achieve social justice, human dignity and economic welfare for all.[371]

Despite being expected to emphasize the role of the indigene in building the human and material resources for a vibrant economy, especially for the urban populace, the government clearly believed in an economy organized along the colonial capitalist ideals, as demonstrated in the above excerpt. The policy paper further stated that Kenya needed to avoid making development dependent on a satellite relationship with any other country or group of countries, yet the high modernist agenda especially for

[371]GoK('Sessional Paper no. 10 1965: On African Socialism and its Application to Planning in Kenya,' 1965).

urban growth remained wired into the western ideals of city planning. To qualify the close ties to the western developmentalist agenda, independence was singled out as not implying isolationism. 'Non-alignment' as the major foreign policy was stated to connote a willingness to borrow technological knowledge and proven economic methods from any country.

Further, Kenya anticipated seeking and accepting technical and financial assistance from any source without strings. The International Bank for Reconstruction and Development (IBRD) and the UN were singled out as permissible partners in development. As discussed earlier, these institutions were in themselves citadels of high modernist planning and Kenya remaining perpetually reliant on their support in development meant remaining vulnerable. Growth from below in terms of increased per capita incomes and technical capabilities remained a pipe dream in the face of the grandeur of western-driven development planning, including water and sanitation provision for Nairobi. As Tischler argues, high modernism's hubris, the belief in calculability and malleability of social, economic and ecological processes, as founded within the elevation of scientific knowledge, thrives through the alliances of politicians and experts (and facilitated by huge financial corporations) by ignoring local specificities.[372] The failure to incorporate the local agency has seen many mega projects of high modernist orientation turn into cash cows for politicians or simply become 'aborted dreams'.

While acknowledging the need for an expanded technical base, this policy paper noted in very clear terms that untrained people could not be used as teachers, planners, engineers, surgeons, doctors, surveyors, architects, managers and administrators without turning growth into decline. Just as it had become apparent that development as envisioned depended heavily on foreign investment, rapid growth would only be realized by supplementing the small pool of domestic trained personnel with large numbers of skilled people borrowed from abroad. It was no surprise, therefore, that the NCC, which was incharge of most of the basic infrastructure in Nairobi, continued to operate and rely heavily on engineers from Europe, specifically Britain, and logistical technical work undertaken by foreign consultancy firms, specifically Howard

[372]Tischler (2013).

Humphreys and Sons Ltd, an engineering firm that had monopolized all major large technological systems undertakings from their actual survey to planning and implementation. By 1965, when this policy paper was being drafted and adopted in parliament in record time to show the government's desperation at defining a development roadmap, only 22 hydraulic engineers existed in the government and only one was of African descent.[373] Seven vacancies were in dire need of being filled and the autonomy with which Nairobi City Council was expected to function, especially in the sourcing offunds, though seen as positive, complicated the task ahead as the council struggled with budgetary limitations and personnel shortages of a critical level.

An interesting twist in the policy paper is its assertion that the country faced a planning failure. Unfortunately, it cited self-help schemes that were expected to harness local resources for development as being initiated and promoted without proper coordination with the development plan. Many municipal and even district projects were not incorporated in the development plan, it was noted. Independent solicitation of external funds by various ministries, including the NCC, as noted earlier, was faulted for the likelihood of reducing the total foreign aid Kenya received. This fear on the side of the emerging autocratic state points towards an obsession of the leadership regime with the power not only to centralize development but also to have control over external funding. More autonomy would have provided a window for locally defined modes of development, especially for the 'self-help' schemes that were expected to be a bottom-linked approach to planning, implementation and management. For the highly controlled urban spaces, there was little room for local participation within the official sphere, hence the characterization of all local-based efforts be they in trade, industry, or land tenure and provision as informal and bordering on criminality.

The assessment of this blueprint leaves a lot of questions unanswered in terms of it been flaunted as a local approach to development. The African initiative and independent path it sought to espouse was a mere public relations exercise. This is because despite the emphasis on the need for autonomy of state, the policy paper put it in clear terms that rapid growth remained hinged on external funding and an external manpower resource. The external appendage in management and technical expertise

[373]GoK('Sessional Paper no. 10 1965: On African Socialism and its Application to Planning in Kenya,' 1965) p.62

would persist. Is it surprising, therefore, that several decades later, urban laws remain the same as during the colonial era and that skills have not evolved to cope with contemporary requirements? Did the optimism and high modernist positivism expressed in the planning blueprint for Kenya mark a boom or doom for the water and sanitation infrastructural development? While much was expected, little seems to have been done in implementing the core tenets, as stated in the policy paper.

5.3.3 Planning for Water and Sanitation for Rapid Growth

As highlighted in the previous chapter, Nairobi had emerged and developed as an 'exclusive' city for the indigenes. It was also an important administrative capital for the colony of Kenya and the Uganda protectorate and a city of choice for a growing number of white settlers. Despite restrictive and repressive laws, it had attracted a sizeable number of indigenous communities, which came to constitute the majority in a disadvantaged arrangement. Independence had promised to reverse the colonial state and secure gains for the local communities along a path they themselves decided, which is what self-rule entailed. However, as discussed above, the high modernism planning ideals came to vehemently define the one and only path to rapid growth as defined by the emerging political class of the petty bourgeoisie.

The financing for the water and sanitation infrastructure in Nairobi had heavily relied onexternal funding from the Colonial Office in London and the establishment of the colonial development fund in 1940 had made it possible to adopt some of the largest supply schemes of the time, which included the Nairobi Dam project and the Sasumua Dam plant, in addition to the expansion of the historical Kikuyu Springs, to revamp their capacity. As Kenya approached self-governance, Nairobi's role in the new state was obviously going to assume even more importance in the region and the high influx of the population in the post-WWII period had plunged the city into a serious water crisis. Increased capacity for the supply system became a necessary undertaking for augmenting its supply. The dire situation demanded that NCC prepare plans for expansion and kick start the search for external funding.

IBRD turned down the application for the Nairobi Water Supply scheme (an extension on River Kibiru within the Aberdare range) made in October 1961, terming it a scheme

for white men, 'a luxury designed system suitable for the standards of white men in Europe rather than majority of the population of Kenya'. It would not merit IBRD/IDA assistance because it would make no significant economic contribution to the development of Kenya. The IDA/IBRD rejection of the scheme in February 1962 meant a reapplication to the Colonial Development Corporation (CDC). However, the application to CDC was scaled down from the original proposal of £1.35 million to £280,000. The NCC's proposals were discussed with CDC during the ministerial delegation's visit to London in August 1962.[374]

In December 1962, CDC agreed to help the Nairobi City Council in financing an extension of its water supply. The scheme, which would increase Nairobi's water supply by 2m g/d, involved the construction of two major and two minor dams for diverting water from the Kiburu River into the existing Sasamua Reservoir. The job was to be completed before the end of 1964. The total cost of this scheme was £280,000, of which the CDC was lending £125,000, repayable over 10years; the balance of the required finance was provided by the Government of West Germany and from the City Council's own resources. The Kiburu River diversion scheme, comprising of two major and two minor intake dams and weirs on the Kiburu River for diverting raw water through a steel pipe aqueduct into the Sasamua Reservoir, was estimated to take from 15 to 18 months to carry out, and was due for completion by the middle of 1964. The water undertaking was wholly owned by the NCC and was operated as a separate accounting unit. All the sums borrowed for the undertakings were secured on the whole of the property and revenues of the NCC *paripassu* with existing NCC loan liabilities.[375]

The Colonial Development Corporation could not get approval of guarantee from the British Treasury for its loan for Kenya. One of the officers in London who was charged with the responsibility of pursuing the matter, an. E.C. Burr indicated:

> The Treasury are naturally rather cautious about their indirectly guaranteeing that the C.D.C. will get its

[374] British National Archives, Kew.REF: CO 852/1790.

[375] Ibid.

> money back since the C.D.C. is established as a statutory corporation that has to take the rough and smooth and balance its books one year with another. That is to say that Parliament has hardly expected that the Treasury, out of another pocket, will help the C.D.C. to balance its books.[376]

Further correspondence revealed that the Treasury had no objection to funding the projects since they had funded the first phase (the construction of Sasumua 1). This funding was to be done on two conditions: that on the basis of the information provided in the CDC's original capital sanction (correspondence document No. E/5 on 1960/62), the volume of water provided by the further development was more than was required at least up to 1970; the CDC suggested that the whole scheme would not have been viable between 1964 and 1966 unless the demand for water was to rise by four million gallons a day. In February 1964, the CDC approved the application for a capital sanction of £300,000 for the Nairobi City Council's scheme for heightening the Sasamua Dam. [377]

NCC proposed to embark upon the heightening of the Sasumua Dam and ancillary works (the Sasumua Scheme) at an estimated cost of £ 1,112,000 to augment the available water supply of Nairobi and district by four million gallons per day(mgd) to a total of 14mgd by about 1966. This was the second stage of the first phase of an overall plan to meet the city's increasing water requirements. The first stage, the Kiburu Diversion Scheme, was underway by NCC with the assistance of a £125,000 loan from CDC that had been granted. The US Agency for International Development (AID) agreed to lend the government approximately £761,000 for on-lending to NCC for part-financing of the Sasumua Scheme. It was proposed that £300,000 be lent by CDC, and the balance of £51,000 be provided from NCC's internal resources. The scheme proposed to raise the embankment of the Sasumua dam 26 feet, 6 inches by the placement of additional clay and rock fill. The spillway, valve tower and footbridge were also to be raised.

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[376]British National Archives, Kew. REF: CO 852/2167 (Folder No. EGD.81/151/02).

[377]Ibid.

The rated capacity of the existing Sasumua treatment works would be increased from 10 to 14 million gallons per day (mgd) by the installation of additional settling tanks and gravity filters. An additional service reservoir would be constructed in Nairobi for increased storage and new 9-inch' to 18-inch' distribution trunk mains laid in Nairobi to replace existing mains, some of which were only 7 inches' in diameter and had been laid 40 years previously. The development was to be spread over four years, with the dam heightening commencing as soon as it was possible. The additional storage reservoir was to be constructed mainly in 1964 and the renewal of trunk mains was to commence in 1964, the whole scheme being due for completion by the end of 1966.

As was traditional, such investment through aid came with attached conditions. The condition for this funding was that part of it would be tied to the procurement ofUS goods and the CDC loan to be used partly in the purchase of British goods. What this meant was that the materials for construction were to be procured from the lending institutions' home countries. This was the irony of such funding arrangements in calculating their net effect in growing local economies. By virtue of the consultancy firms being also western owned and enjoying huge monopolies, as was the case with Howard Humphreys and Sons of London, it was not difficult to imagine that over 70% of these funds remained abroad. As a form ofloan funding, it would, thus, land the local economies in perpetual debt, especially when these grandiose projects failed to achieve their revenue targets to comply and meet the cost-recovery principle. This would see theimpoverished urban class being thrown off the grid as the large technological systems of supply continued to connect the middle class that was comprised of civil servants and the upper class that was made of up of the ruling class and those who owned the means of production in the nascent state that was Kenya. The plight of the poor, caught up in the ideological rifts amongst the political class, remained rife and rose to almost fever pitch up to 1966, sparking the resignation of the then vice-president, JaramogiOginga Odinga. He was seen as thesymbol of socialism and was a key advocate for a welfare state that responded to the needs of the masses. Subsequently, his exit and the formation of the first opposition party in 1966, the

Kenya Peoples Union (KPU),[378] and its subsequent crushing, meant the triumph of capitalism as packaged in a highly modernist agenda of development.

The success in suppressing ideological dissent in the upper echelons of power in the country meant that the urban underclass was, to a large extent, left to its own means. The complexity of their plight resulted more from the government's indifference towards the fast-growing cadre of the urban unemployed and informal sector operators. As the central government fought hard to consolidate political power and develop the economy, colonial urban governance laws remained mostly intact, to the detriment of the poor in informal settlements. The government continued with the massive slum clearance policies of the colonial era.[379] Informal areas were seen as an'eyesore', deserving outright clearance rather than consideration for extension of water and sanitation infrastructure. As rhetorically expressed by one of the strongest proponents of high modernism, Le Corbusier, '…those who come from the countryside to make their future are simply a dead weight on the city and an obstacle, a black clot of misery, of a failure, of human garbage?' The poor were simply unwanted within the arrangement of the modern city. Yet, radical urban planner Jane Jacobs points out that while the slum might not have much social capital, what it did was something to build on within the realm of change, renewal and invention.[380]

The indifference with which the city authorities treated the urban low class in Nairobi sparked even more questions in relation to the new Kenyan government's commitment to its pledge of improved livelihoods for all, as stated in the socio-political and economic planning blue print of 1965. In retrospect, the government, in partnership with the United Nations, sought to cope with the serious problem of urban housing in the 1960s. Their efforts paid off with the establishment of the National Housing Corporation (NHC).[381] Through the on-siteservice schemes, low cost housing projects were undertaken, with the extension of the city's water supply network and sanitation systems that were hybridized either through septic tanks or direct overflow into the council's mains. However, this resulted in gentrification as the cost-recovery model

[378] Ochieng' (1983).

[379] Olima (2001).

[380] Jacobs in Scott (1999).

[381] Obudho(1983).

employed as part of the terms for occupation made the built houses and complementary infrastructure systems unaffordable to the urban-poor. The middle-income group, mostly consisting of public servants, ended up occupying the houses to the predicament of the poor. Since most informal settlements resulted from gentrification, and had developed adjacent to most of these housing projects, it can be argued that the proximity to these planned areas provided an avenue for water supply, either through illegal tapping into the system or purchasing from households and standpipes at these 'on-site service' scheme sites.

The notion of exclusive spaces and exclusive infrastructure took shape, not through a conscious initiative to push the urban underclass off the grid but as an unintended consequence of the capitalist model of economy favoured by the president, Jomo Kenyatta, and his loyalists within the highly polarized Cold War atmosphere. While informal settlements developed as a form of self-initiative of urban low-income households, the attitude and response of national governments consisted of active hostility or benign neglect, adopting measures ranging from passing tough, stringent regulations to excluding such settlements from any infrastructural extension plans to outright demolition.[382] While the Kenyatta regime continued the 'slum' eradication programme through outright demolition, as had been the case during colonialism, Kibera and Mathare, for reasons known to the authorities (perhaps political), remained untouched and continued to receive more people, including new entrants and evictees from the other informal areas.

In the 1950s, as cited by one of the respondents interviewed, the colonial government channelled water to Kibera, but this extended to the Makina area of the settlement only; Makina lies within the proximity of the major housing projects and the District Commissioner's office, which is served with pipe water and a functional sewer network. The independence governments, as earlier stated,did not feel obliged to provide services, including water, to the Kibera Settlement, which was seen as an illegal settlement. The haphazard construction of houses and the illegal allocation of land did not allow for the provision of water.

[382] Richard in Barkan and Okumu (1979), see also Aduwo and Obudho (1989), Gilbert and Gugler (1992), Lamba (1994), Ngau (1995) and Kayongo-Male (1998)

Just as sanitation and the construction of latrines were never a priority of the structure (rental houses) owners in Kibera, water supply never featured in their plans. Shelter seemed to be the primary concern of the residents and this left them vulnerable to unscrupulous developers. Water kiosks, standpipesand vendors continued to dominate the water supply chain and increased settlements in Kibera opened up to strained sanitary situations, with less options for remedial intervention. According to the field interview conducted, the bucket system of emptying the shallow pit latrines thrived but it became a challenge to the river supplyas the bucket emptying would take place on the riverbanks.[383] This was not only a threat to the residents of Kibera settlement whose river water usage declined but also to the Nairobi Dam which relied on these rivers that traversed through Kibera and other informal settlements for its source.

As for Mathare, the government encouraged the selling of land through land-buying companies. This, in away, helped as a number of companies, throughself-help initiatives and the pooling of resources, otherwise identified as the *Harambee* spirit in the government blueprint, managed to undertake not only the building of a shelter for its members but also provided water through communal standpipes fora fee. The land buying co-operative societies, as they were known,provided membership through a share ownership system and after the purchase of land, they either built and subdivided the houses amongst the members or sub-divided the land and left it upto the owner to put up structures. The membership or number of shareholders of the companies varied greatly from 3 to 520. In the case of the larger ones, a committee was selected, but the smaller ones saw all members join the committee. Inflated land prices meant that purchase by the 'squatters' could only be through such companies. This was a classic scenario of a bottoms-up approach to development and urban growth.

As non-controlled development sites, people had the autonomy to employ local expertise and resources to procure their own livelihoods. They utilized local building materials to put up brick houses with corrugated iron roofs or semi-permanent mud and wattle houses. The corrugated iron roofs were utilized for rainwater harvesting and, where streams were available, they were protected to minimize pollution. The Mathare River remained an important source of water for brick-making, washing and other

[383] Abdalla Omar, Oral Interview, 3rd August 2016. Kibera, Nairobi.

domestic purposes. As for the groups that could raise enough capital, apart from putting up relatively better-designed houses for owner occupancy and rental purposes, they were able to lay piped water and make septic tanks and cesspools for sanitation purposes. Standpipes were strategically located at central points in the settlement to sell water to residents, for which a price was set using the standard container referred to as a debe. This carried close to twenty litres of water cost between 20 and 30 cents.

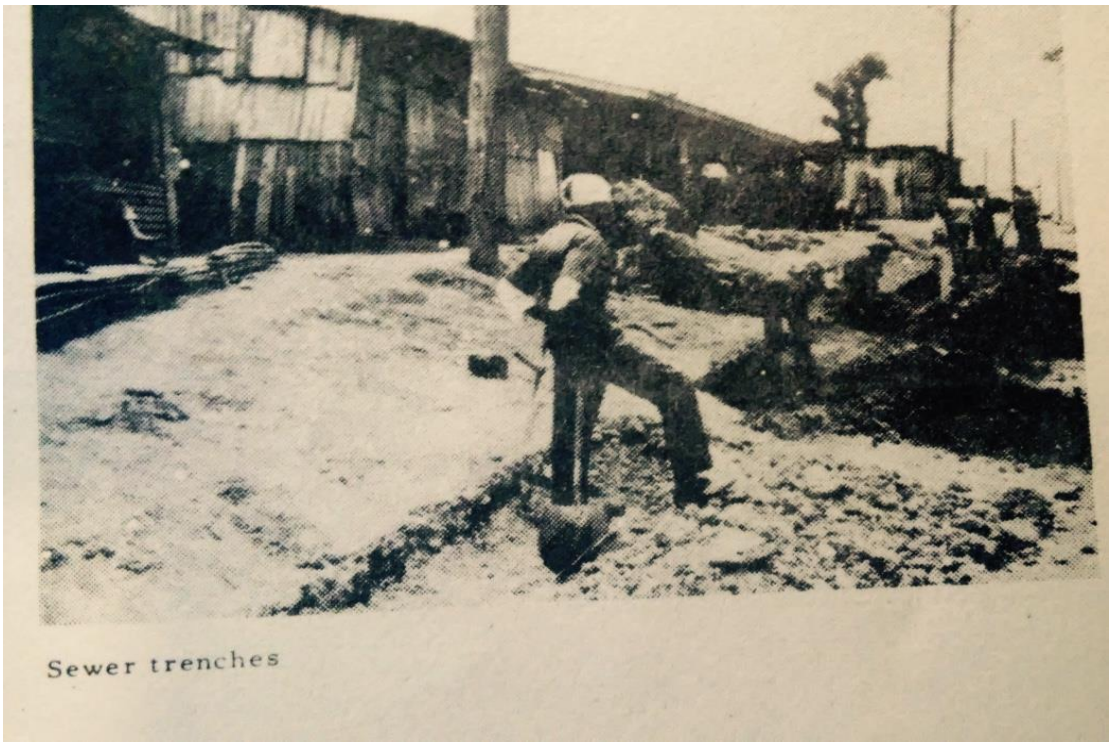
Images 12: Mathare Development: A case of bottoms-up approaches

(i) Communal water standpipe

source: Etherton, D.1971

The photo shows a water dealer (seller) and residents purchasing water from a communal standpipe tap using a 'debe'—a metal container that was adopted as a standard measure in terms of value per capacity.

(ii) Sewerlines: construction in progress



Source: Etherton, D.1971

(iii) On-site laying of PVC pipes for water supply

Source :Etherton, D. (1971)

The photos show a communal approach to developing infrastructure by relying on local initiatives. By organizing into land buying companies and enjoying tenure security, the incentive to improve their livelihoods by laying water infrastructures increased. Such self-organized approaches shaped and improved access by employing the creativity of members in reproducing locally situated technical approaches like communal water standpipes, drainage trenches, shared pit-latrines draining into septic tanks and water storage facilities, and roof-water harvesting.

In the late sixties, NCC came up with a plan for the redevelopment of the vacant land at the western end of the Mathare Valley. It was proposed that this would avoid some of the impediments that had bedevilled the UN-popularized and National Housing Corporation-implemented on-site and service schemes. Though the principles of this proposal by NCC were embodied in the council's 'site and minimum service' project, the council decided to provide a waterborne sewage system disposal were the plans to materialize.[384] Apart from the question of public utilities, all the proposals for this plan were based on the assumption that security of tenure would be handed to individual heads of households. Except for the schools and other public facilities that were put off site, the council was to adopt two housing schemes, namely the 'Site and Minimum Service', which entailed the construction of 6 room houses on 513 plots measuring10.5 metres by 12 metres each; and 'Aided Self-Help', which would see three roomed houses put up on 760 plots, each measuring 7.6 metres by 11.5 metres.

However, as David Nilsson notes, the city engineer's department had thought that by adopting low cost housing schemes involving the use of local materials and design requirements, the housing menace would be nipped in the bud.[385] But the conflict with the Ministry of Housing, in whose docket housing was located, meant another plan was shelved. This case of how the duplication of functions and patronized development hindered localized approaches to problem-solving would also affect water provision, which was a function of the Ministry of Agriculture, Animal Husbandry, and Natural Resources, and later shifted to other ministries that morphed from the parent one. As for sanitation, emphasis continued to be placed on the water supply, without a concerted effort to secure the means of getting rid of wastewater. Sanitation received less attention in the prior years, thereby seeing the popularization of either open defecation or the use of septic tanks; yet due to water shortages, borehole(s) continued to be explored as supplementary supply systems.

Along with the housing problem, it goes without saying that the government, through the city department, found themselves trapped in the neo-colonial web due to limited resources and the personnel to re-engineer inclusive infrastructure regimes. As

[384]Etherton(ed.) (1971).

[385] Nilsson (2017).

highlighted in the conclusion of the previous chapter (Chapter Four), the exit of direct domination by the British colonial masters was replaced withnew forms of control through financial institutions that lentexpertise and financial support. The nature of large technical systems as grand investments warranting heavy funding exposed the government's underbelly to the instruments of neo-colonial control.

Despite the highly polarized political climate of the first decade of independence in Kenya and the indifference of thegovernment to the underclass of the explosively urbanizing Nairobi, the primacy of expanding the water networks to deal with the perpetual shortage and mechanisms of managing the subsequent wastewater remained of paramount concern to the NCC authorities and engineers. Negotiations with the various national departments in charge and the international financial agencies went into top gear starting as early as 1964, promising the start of major projects. Apart from physically planning for infrastructure, major re-organizations and re-alignments at the national level were seen to be a way of streamlining the management of water resources.

Interestingly, the government's water development policy was the responsibility of the Minister for Agriculture, Animal Husbandry, and Water Resources. Under the Water Ordinance (1951), the minister had a number of statutory powers and duties affecting not only water development, which was sponsored and executed within his own ministry and the ministry of works, but also water development undertaken by municipal and other local government bodies and private companies. However, the Water Resources Authority, as a supervisory authority in water development, had the mandate to appropriately advise the minister on water matters. Water resource management was further delegated in a hierarchical structure to the five urban local authorities in Kenya as of 1964, which included Nairobi. Amongst the local authorities, Nairobi had a greater mandate as it was in charge ofthe water beyond its official boundaries, covering some townships like Kikuyu. The reason for this could have been because Nairobi's major water resources derived from neighbouring ecological zones, mainly Kikuyu and Ruiru.[386]

[386] KNA (BV/138/64).

Another unique factor about Nairobi City Council is the fact that unlike the other four urban local authorities, it had total autonomy in raising funds for its projects. The rest relied on government funding while NCC could negotiate with partners for funds independently. All the councils, including Nairobi, employed consulting engineers from outside for their major design works and also had their own local engineering staff. The government's chief hydraulic engineer scrutinized their designs when applications for funds were made to the Local Government's loans authority. The Minister for Local Government exercised supervisory powers over all local authorities, obtaining his technical advice from the appropriate department of government. Water supply management and operation by local authorities was subjected to certain checks and controls on the adviceof the chief hydraulic engineer.[387] An analysis of these institutional arrangements leads to the conclusion that the managerial overlaps prompted delays in making key decisions and conflict in the management system, especially within the politically polarized environment that characterized the 1960s and early 1970s, as highlighted earlier.

Despite the shortage of personnel and the restructured institutional arrangement, NCC prioritized expanding its water network as early as 1961. Planning for the projected urban population and industrial growth informed most discussions, and reforms were of paramount urgency.

By 1964, the debates on how best to manage the water resources had become inevitable and invited broader discussion. This is contrary to what many scholars have posited: that the water reforms agenda in Global South countries is an issue from the 1980s onwards, particularly in the post-structuralist period. As early as 1964, the centralized network system of water and sanitation services provision for Kenya and Nairobi, in particular, was being faulted, and avenues for reforms tabled. For instance, the minutes of the Water Resources Authority, which was an offshoot of the national government, as pointed out earlier, stressed that some countries, particularly the less-developedand, notably, ex-British colonies, had attempted to reach the ultimate solution at an early stage in their development by placing all water development under central government departmental control.

[387]Ibid.

Consequently, the system ended up being obviously weak. The reason for this weakness as noted in the archival documents was basically financial. Water undertakings, whether dealing with pure domestic water, raw rural water, irrigation waters, or sewerage and drainage wastes are essentially industrial enterprises, and to attract outside capital, must be run on business-like lines, be efficiently managed and be self-supporting.[388] However, informed by this assertion and the justification for the need for reform of the water and sewerage service sector, this simply served to fan and exacerbate the belief amongst the critics of the government that it was in favour of surrendering dynamics its social responsibility to the market. As will be highlighted in this chapter, the prevailing politics informed many decisions appertaining to the technologies to be adopted in dealing, especially with the rampant water crisis in Nairobi. To borrow from the Weberianconflict perspective, as espoused by Mikael Hard,[389] the ideological differences played out through political competition and the government favoured an economic structure and a social distinction agency. This retroactively affected major shifts not only in dealing with the water and sanitation infrastructure inadequacies of the 1960s into 1970s, but also informed the technological measures to be employed, for example, metering and the pricing of water. The process of negotiation and approval of the grand technical systems of water and sanitation brings into perspective several forces, including the conflict of interestbetween several actors, for example, consultancy firms. A case in hand is the ambitious Lake Naivasha water abstraction scheme for Nairobi that never saw the light of the day, butwas one that put a wedge between government officials supposed to be working in tandem.

The monopoly by Howard Humphreys and Sons Engineering Consultancy firm for the major water works in Nairobi from the colonial period also comes to the fore. This proposal perhaps becomes not only a clear case of how development was not only pursued on the modality of sound investment policy but was also mired in international politics, pitting global powers (in this case, seemingly between British and French engineering consultancy firms) and the local politics of former colonial settlers who

[388] ibid

[389]Hård (1993).

had remained in the country after independence practising farming and to whom the Naivasha waters meant a recreational facility for their bourgeois lifestyles that involved fishing, swimming and bird watching. The over indulgence by these sons and daughters of colonial ranch owners and their kin and friends from Britain saw Naivasha being called 'the Happy Valley'. It was both an important agricultural zone and a leisure spot.

5.3.4 Competition and Power Dynamics to Provision

Nairobi's dire need for water and the alarming rate of population growth created an environment that required all stakeholders in the water sector to imagine the unthinkable. Traditionally, science has been relied on to provide solutions to stubborn challenges like that of water for Nairobi. It is within this realm that Lake Naivasha, which lies 40 miles away from Nairobi, was earmarked as a viable option for stabilizing the water supply system to meet the skyrocketing demand. With the country yearning to industrialize fast, water demands were beyond the existing capacity and the under-connected sanitation technical systems.

5.3.4.1 Peeling Off The Political Mask In High Modernist Planning

Despite Kenya having attained political independence in 1963, the repeal of the constitution in 1964 to establish a republic and lay the foundation for a strong centralized government provided the impetus for take-off. For water and sanitation in the major cities of Nairobi and Kisumu, there was aconsensus on the need for the development of master plans. The WHO advised a UNDP application should be submitted for this goal of supply. The government treasury department declined this approach.[390] It first clarified that it was in full agreement that these two cities very much needed master plans for water and sewerage and that such guides should be developed on an urgent basis. But the question for them was: how many such plans could be developed most quickly, competently and economically?

In the treasury's view, the UNDP approach would have taken too long and, thus, they favoured obtaining bilateral technical assistance to do the job. At the same negotiation table, four options were floated: one was that the NCC could hire the necessary staff

[390]KNA (EPD 56/64/04)

(higher level expatriates plus junior supporting personnel) at a minimum cost of about £200,000; a second was thatthe NCC could employ a consulting firmfor perhaps the same amount; a third was that the UNDP could be asked to do the job, the cost to Kenya being £20,000 in cash and £186,000 for support staff services; and a fourth was that donor countries could be approached for technical assistance, which would also involve a substantial amount of supporting services. It was emphasized that the recommendations made by a UNDP team would be the most favourably regarded by the World Bank, which, through its East Africa representative, had already stated that it would work with the UNDP in selecting the team and supervising the study. The technical assistance situation would be the next preferable one from the Bank's point of view. This notion was reinforced by the belief that since the Bank would certainly be the principal source of loans, it would save a lot of time by settling on an option of their preference.[391]

It is at this juncture that it is imperative to state that, the migration of ideas, ideals and models of infrastructural outlays from the Global North to the South and using the case for Nairobi was reinforced in the post-colony through the key financial institutions, either as direct financiers or supervisors or by providing technical support. Lack of financial clout compelled the NCC to adopt options that appealed to the donor community rather than relying on home-grown expertise and independently pursuing their own projects. A consensus in water infrastructural development for Nairobi thus did not imply a negotiated agreement but one more of compulsion.

The Nairobi City Council,therefore, subcontracted Howard Humpreys and Sons Consulting Engineers of London to do hydrological surveys on the possible water supply schemes for Nairobi. Reports submitted by the consultants in March 1961 and January 1966 had recommended the development of a source of water on the Chania River in exploring the question of what the possible future supplies were for Nairobi. A population of 895,000 in 2000 was estimated, with a demand of treated water of 62.7 mg/d.[392] In January 1967, the City of Nairobi Planning Report No.1 gave high and low forecasts of population for the year 2000 of 4,549,900 and 2,221,300 respectively.

[391]Ibid.

[392]KNA (EPD/SC2/094).

The corresponding first estimates of treated water demand were 182 mg/d and 111 mg/d respectively. This figures were, however, liable to change based on future studies. The consultant's report vouched for the Chania-Kimakia-Thika catchments water schemes, terming them the most economical.

On the same wavelength, as required, Howard Humphreys and Sons submitted their report on Lake Naivasha as an alternative source. However, this report was damning and revealed the power play and underhand dynamics of large-scale technical projects. The summary report submitted to NCC in May 1968 referred to studies of the pumping of water directly from Lake Naivasha to Nairobi. The conclusion reached was that the reliable yield obtainable would be less than 5mg/d and that the cost of water would be much higher than from other available sources. [393] The recommendation by the consulting engineers for the dropping of the Naivasha project did not go well with some powerful officials of the Water Resources Authority. They doubted the report's findings, laying the fault on many of what looked like shoddy and contradictory conclusions. The report, thus, became an instrument of contestations within the broader perspective of possible alternative supply systems for Nairobi. Those who opposed this report were strongly in favour of having an informed hydrological survey report on Lake Naivasha and boreholes as alternative supply links.

On the question of the cost, which was rated as high and uneconomical by the consultants, the senior Water Resources Authority officials, who were of British descent, stated that in pumping the Lake Naivasha or the borehole scheme, most of the expenditure would have to be incurred to justify it, because it was uneconomical and often technically impossible to raise up the dam (going by the favoured Chania project) by small increments, while one could increase the pumping time or drill new boreholes to follow the increase in demand.[394] Another take by the experts was that pumping the lake at the rate of 5mg/d would have caused the lake to be pumped dry. This assertion was termed far-fetched by the government officials who opposed the validity and reliability of the report. They implored that even in accepting the statement as presented, it was not up to the consulting engineers to decide whether pumping the

[393]KNA EPD 56/64/04

[394]EPD 56/64/02

lake dry was a good thing. They felt that only the government could decide whether recreational considerations outweighed the economic benefits of the project. As those economic benefits had not been stated, it was impossible to take the decision at that stage.

One indictment of the report that seemed strange and caught the eyes of its doubters was the observation that a dam considered on one of the tributaries of the lake (Turasha River) would be capable of supplying 37mg/d. This was rated as the most favourable option by the consultants. The question that arose was that if 37mg/d could be abstracted from one of Lake Naivasha's tributaries, more than three times Nairobi's supply at that time, then it was difficult to understand why a much smaller quantity taken from the full lake would cause it to be pumped dry.

On the question of Lake Naivasha's water fluoride content, the government officer, though in doubt of the report, refrained from belittling it. The officer weighed in on the options of minimizing the fluoride by either mixing the water with that from the Kikuyu plant or reducing the fluoride content through filtration. Another angle to this was introduced by stating that of Nairobi's total water consumption, only a very small proportion was actually used for human consumption. Thus, it was believed to be foolhardy and inordinately expensive to reject completely a suitable project for use representing 3% of total consumption. Hence, fluoride-free water would be sold in bottles for human consumption only.[395]The senior government official finally, in his report, concluded that there were powerful interests working against any abstraction of water from Lake Naivasha, and that health considerations, though not negligible, were to some extent being used as a smokescreen for what were mostly recreational reasons. Kenya still had a large population of Europeans owning large tracts of agricultural land and strongly linked with the government. As such, their use of the lake for recreational reasons was alluded to as being the force behind the unsubstantiated rejection of the Lake Naivasha project.

Based on a comparison between the Chania project and the one on Lake Naivasha, it is clear that there was a strong bias at play. Chania had begun on a small scale and

[395]Ibid.

would gradually increase with the construction of the dam. Boreholes as an alternative were considered by some quarters as most important, not just because of the additional volumes that couldbe brought in from underground but also because of the way it being tapped as a resource could materially affect the capital and maintenance outlays for reticulation. After reviewing a map which showed that high fluoride water lies under Central and Eastern Nairobi, with low fluoride content on the west and north east, it was found out that the city officials could agree with the consultants not to undertake to connect outlying growth point to the city system if they could privately develop acceptable water supplies from boreholes. However, for those areas without such access to good water, which included large regions occupied by low-income families, water could be supplied from the city system.

Another aspect that remained divisive at this juncture in the attempt to address Nairobi's water crisis and anticipating future development was that of raising the water rates. While some ministry officials and the consultants vouched for increased cost of water as a way of stabilizing consumption and effecting new behavioural water use practices that were more oriented to conservation, such as by refraining from watering flower gardens and lawns, the Minister for Agriculture, Animal Husbandry, and Water Resources, Bruce Mackenzie, noted that water rates could not be increased in an election yearunless if they were clearly linked to a project for more water.[396] This he cited was politically impossible and, as noted in the minutes of one of his meetings with water officials, he was so firm in his rejection that no further discussion on the issue was necessary. Bruce Mackenzie was one of the British nationals with a strong link to the settler community who had politically angled themselves to secure the interests of the white farmers unwilling to exit Kenya. His support for the consultant's report against the Naivasha project was derived from the belief that he was amongst the interested parties who wanted to secure Naivasha both for recreation and support for agriculture through irrigation. The NCC was complicit in this matter and embraced the consultant's report.

Mr. Laulanie, a senior engineer from the water department, took a strong position against the report, further tabling evidence of existing hydrological studies by his

[396]KNA EPD 56/64/04.

department that supported the view that 40-50 mg/d could be withdrawn while keeping the lake at about 25 miles. However, his views received no consideration, further pointing to the suppression of expert voices on many major decisions undertaken either by the city council or the government. Many experts in the government water department, most of them engineers of reputable experience in India, South Africa, and their home country, Britain, felt frustrated and depressed by the outright dismissal of their opinions either for political gains or in favour of a single sourced consultancy firm. As evidenced by Mr Laulanie's personal opinion in a short letter to other members of his department, they would adopt a strategy of saying nothing in subsequent meetings.

Reflecting on these events of 1968 following the release of the report on possible future water supply alternatives for Nairobi, it is clear that the process of developing infrastructural projects has many aspects other than the design works by engineers. Artefacts are controversial and promote certain ideals that are either premeditated or arise as unintended consequences of decisions made at different levels by various players. However, politics and economic considerations inform these processes more than any other. As Winner points out, the very process of technical development is so thoroughly biased in a particular direction that it regularly produces results that are counted as wonderful breakthroughs by some social interests and crushing setbacks by others.[397] The process of adoption of certain technologies is equally conflictual and coercion or submission is integral to instituting them within society.

5.4 Inertia, Shrinking Economies and the Politics of Infrastructure Funding

As intimated earlier, the 1970s marked a downturn in the economic fortunes of most of the infant states in Africa that had laboured a great deal to remove the shackles of several decades of European colonialism. The first decade of the 1960s, during which most countries had gotten self-rule, had seen countries like Kenya, and Nairobi as its capital, ride high on a wave of increased investments and improved social welfare status.

[397]Winner (1980).

However, the global economic crisis occasioned by the 'oil shocks' of the early 70s, coupled with population explosions in the urban areas, led to most states being incapable of financing and undertaking major development projects, especially for water and sanitation, which were key services to emerging and developed cities. The primacy of water and sanitation systems that are adequate and functional, thus, necessitated the entry of global external financial players into the array of infrastructure provisioning for what was then referred to as the 'developing or third world'. The debate was not only on the provision of those services but on appropriate technologies and stopgap measures which included population control.

It is important to note that population and infrastructure planning cannot be divorced as they are directly proportionate. The UNDP, in its acknowledgement of the close-knit relationship between water and public health, empowered the WHO as its partner agency to refocus the provision of water and sanitary infrastructure systems for Nairobi by soliciting funds for development from the World Bank through bilateral agreements and multi-scale cooperation. In the same respect, several studies were undertaken to establish the long-term and short-term needs for Nairobi against the backdrop of the then prevailing challenges.

In the 1970s, the government realized the crucial role played by the water sector for the country's general economic growth. Therefore, in 1974, the Water Department under the Ministry of Agriculture was elevated to a full Ministry of Water Development, with the mandate to actively steer the water sector activities. Due to the positive economic growth at that time, the ministry aimed at increasing coverage through its motto of 'water for all by year 2000'. [398] A new plan of action was initiated, aimed at investing more resources in the water sector to improve efficiency and expand the water services to as many citizens as possible. In order to ensure the success of this new move, the government moved in with a very ambitious programme and took over many water supplies which were previously managed by the local authorities, local communities, and other public and private institutions. This programme was, however,short-lived as the government realized that it was constrained in terms of resources for investment.

[398]KNA , Ref. No. K333.91 WAT, Nairobi, Kenya.

Assessing the situation for Nairobi, a report on the future water supplies for Nairobi identified in 1973 that water conservation was the only viable solution for the critical water crisis. With the consumption figures approaching the city's maximum production capacity of 17.5 million gallons per day, the situation was threatening to get out of hand. The report stated that there were no real immediate possibilities of increasing water production, so consumption had to be reduced through restrictive measures by involving more public participation to understand the crisis.[399] It was not the first time conservation measures were being proposed for Nairobi, afterwitnessing the public campaigns of the 1940s. Water-intensive industries within the city were highlighted as aggravating the situation.

Water was and had to be taken as a development resource that was limited in supply and had to be considered along with other inputs in planning and designing development activities.[400] It was further noted that experience with self-help water supplies had shown that the small-scale water schemes worked very well.[401] However, the over emphasis on the larger river water supply schemes led to a push for large-scale self-help schemes. This in itself was a setback because what it meant is that the larger the scheme was, the greater the operational and maintenance costs, which would lead to unsustainability.

Despite Kenya having realized greater economic potential during the first decade of its independence, the oil shocks of the early 1970s reversed all the economic gains, leaving the government vulnerable. Major government projects, including water works, had to heavily rely on the donor community for financing. The 1974-1975 period saw the World Bank become a major stakeholder in the water provision, not only for Nairobi but for the entire country. UNDP partnered with the World Bank to finance a number of hydrological surveys in an attempt to augment the water supply for Nairobi.

[399]KNA (RN/6/42).

[400]KNA (AMB/6/69).

[401]Ibid.

In March 1975, a special technical study report prepared for WHO as the executing agency for UNDP was done.[402] The report gave its survey report on Nairobi's groundwater. It was noted that the Nairobi area, by 1975, had 330 boreholes scattered throughout. Of this number, 225 boreholes were privately used at an average extraction of 5,700 gpd/borehole. An important observation of the report was that the private boreholes were being operated at a lower extraction rate than the public and industrial boreholes. The assumption was that some of these private boreholes could be revamped to extract at a much higher rate. It was further noted that 30 to 40 boreholes had been abandoned but could be restored to extraction. More ground water surveys were recommended.

With state intervention in infrastructure planning diminishing fast and international financial institutions augmenting their role in designing, prescribing and implementing plans, infrastructure provision was emboldened into 'international best practices' that further alienated local initiatives and user agency. It was not long before the question of viability started dominating debates in the financial capitals of the North, and this saw ideas around appropriateness of technology represented by the use of local expertise and local materials, and investing in small technologies receiving an audience.

5.5 Chapter Conclusion

While the pursuit of a high modernist developmental agenda characterized the 1960s into the 1970s, the utopian goals envisioned remained as suchdue to the failure to incorporate the local initiatives. Independence gained was no independence as international financial players continued to set the agenda for the Global South states through neo-colonialist ties. Their technological prescriptions marketed as wholesale commodities rather than to reduce urban poverty reproduced urban squalor, suppressing the potential for improved accessibility to social services. If the Mathare case in the early 1970s is an example to go by, it demonstrates that bottom-linked approaches that see the indigenes and non-formalized technologies or what can be identified as small-scale approaches possess greater potential in spurring development through expansive access to services, whether through networks or fragmented and

[402] KNA(GP.628.114 Nai)

devolved systems. The faltering start of the first two decades auctioned the Global South to western ideals of urban development and the entry of the global institutions like the World Bank, which had an expanded mandate from its former IBRD. The UNO, through UNDP, WHO and other agencies, continued to prescribe solutions that purported to consider local involvement. The pattern of development adopted, and the bracketing of indigenous systems of thought, survival, and development as bordering on illegality, militated against technological invention and innovation in the water and sanitation provision for Nairobi despite its continued existence as a water deficient city. However, it will be interesting to explore what some of these initiatives that were broadly categorized as 'appropriate technologies' were able to achieve. Did increased funding tip the graph positively towards more inclusive city planning, access and recognition of bottom-linked approaches as viable technological options in the face of disintegrating and non-performingcentralized technical systems of supply?

CHAPTER SIX

ECONOMICS AND POLITICS OF WATER/SANITATION PROVISION: CONSTRAINTS, TECHNOLOGY SHIFTS AND PROSPECTS FOR THE FUTURE, 1979 TO 2015

6.1 (In) Appropriate Technologies and the Globalist Rhetoric in Water and Sanitation for Nairobi

As many studies reveal, the development of public services or utility companies in the North to at least some semblance of universalized status, where no one was excluded, was a process full of conflict spanning more than a century.[403] Yet, despite this , it was taken for granted that to supply similar services in the emerging Global Southin the post-WWII era, it could take a shorter time span, perhaps with importation and implantation from the North being seen to necessitate such optimism. The South was expected to emulate these 'best practices' and the 'power of the machine' from the North through replication and adoption without adaptation, hybridization or even rejection.

The process of appropriating incoming technology, as earlier espoused, was assumed to be a passive process flowing seamlessly from the upper echelons to jumpstart the 'lower' cadre societies. The political and institutional preconditions were ignored, with service provision being largely seen as a matter of expertise and funds.[404] However, the optimism placed in the efficiency of large technologies construed and conceptualized from 'without' (the North) and believed to be actualized in the new frontiers (the South) by renowned experts (engineers and economists),along with huge budgetary allocations from global financial institutions, ended up as mere illusions by the dawn of the 1970s. Was development from below, therefore, the integral missing link for attainment of improved livelihoods? How did the fragility of the state and the developments in the last quarter of the 20th century shape the water and sanitation socio-spatial outlay of Nairobi in terms of modalities and technologies of provision?

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[403] see de Swaan (1988)

[404] MarikenVaa and NordiskaAfrikainstitutet research report no.94, 1993.

The following sub-sections attempt to re-question the popular dynamics in water and sanitation provision, and their use, meaning and effect. This is in line with the central theses of technological non-neutrality, appropriation as a multifaceted process that manifests at an individual level within the day-to-day life provisioning and the location of the indigene in the debates appertaining to science and technology studies.

6.2 Appropriate Technologies: Meaning and Implications

Arising from 'oil shocks' of the 1970s, many polities in the Global South found themselves at the mercy of international financial and humanitarian players. The utopian high modernist and optimistic technological paths of the immediate post-colony had proven expensive. Most had ended up as'white elephants' in the face of booming urban population and exponential rate of poverty. While the role of the state in socio-economic spheres of life in most countries was dwindling, as occasioned by collapsing economies, the vacuum created was fast being filled by developmentalist agencies from the North.

However, the issues of instituting a paradigm shift in managing the social services sector that includes water and sanitation was of necessity rather than choice. External funding, though conceived under the pretext of spurring fast and guided economic growth, left the Global South in a precarious position. Such growth entailed charting independent economic growth paths that tapped into the local potential in terms of indigenous people's manpower and technical power. A change of tact in terms of not only the question of technologies of provision and development but also on the approach mechanisms adopted by the key actors, mainly the state and international financiers was necessary. If the planning models and technological designs of the period leading to the 1970s had alienated many people and created poverty rather than wealth, 'appropriate technology' movement's basic principle was to try to help people develop out of the situations they were in by providing technologies appropriate to those situations, but which afforded some improvement in users' economic and social circumstances.[405]

[405]Fressoli and Around (2015), p.9.

The failure by the developmentalist blueprints,[406] to translate into any tangible growth, increasing creativity and alleviating poverty, meant that the blueprints themselves and their theories of development had to be subjected to scrutiny, re-questioned, and if possible, overhauled.

It was within such a necessaryre-questioning of technology and the development agenda modalities that 'appropriate technology' (AT) found resonance with the economists and planners who sought to redress the failures in the economies of most of the Global South, especially in the period approaching 1980 and onwards. As Fressoli and Arond observe, between the 1970s and 1980s, 'appropriate technology' became a worldwide grassroots innovation movement that sought to redefine technology as a tool for development in South America.[407]

In 1973, Schumacher, a renowned economist, published his mercurial seminal work, '*Small is beautiful: A Study of Economics as if People Mattered'*. As a result, debate on the need to rethink development by incorporating ordinary people became common. Cast against the backdrop of crunching economies, indigenous technologies and, basically, the incorporation of people into planning gained root. The idea of 'small' (indigenous) and 'large' (Western) technologies had earlier been elucidated in Gandhi's writings and his vision for India. He had stated clearly that he visualized electricity, shipbuilding, iron works, machine making, and the like existing side by side with village crafts, but if the same work could be done by a small machine, then to him, there was no need to employ a large one.[408] Technology had to work for the good of humanity rather than the end goal being large-scale production for profit.

Through the founding of the Intermediate Technology Development Group (ITDG) in London in 1965, Schumacher together with his colleagues, George McRobie and Julia Porter, became the progenitor of 'intermediate technology',from which 'appropriate technology' as a movement sprouted and gained roots progressively.[409] In using the term 'intermediate technology', Schumacher envisioned a technology that was an 'in-

[406]See Carr(ed.) (1985)

[407]Ibid. p. iv.

[408]Arndt (1987), p.156.

[409]See Willoughby (1990), p.68.

between' or rather one that was midway between, for example, a hand hoe and a tractor.[410] As propounded, the concept of 'intermediate technology' transcended the issue of relative modernity; but the fact that efficiency and modernity were not necessarily correlated reinforced the assumptions concerning technology choice, which was claimed to underlay 'intermediate technology'.[411]

A USAID 1976 policy document titled, *Proposal For A Program In Appropriate Technology,* defined AT to be intensive in the use of domestically produced inputs and also in the use of less capital and few highly trained personnel. Further, it explained that ATs were small scale but efficient, replicable in numerous units, readily operated, maintained and repaired, of low cost and accessible to low-income people. In terms of the users or beneficiaries, appropriate technologies were claimed to have sought to be compatible with local cultural and social environments.[412] All in all, for the lead proponents of AT, 'intermediate technology' as the founding concept had to be simple so that the demands for high skills were minimized not only in the production process itself but also in matters of organization, raw material supply, financing and marketing, and that production had to be mainly from local materials and mainly for local use.[413]

The economic meltdown of the 1970s gave a new lease of life to the concept of development through small-scale approaches. The future lay in bringing on board indigenous modes of production and sustenance not only in rural agriculture but also in terms of technologies of procuring social services like water and sanitation. It is also important to observe that large and highly sophisticated technologies were slowly being questioned for their ecological impact, hence the attempt to describe some small technologies as 'eco-technologies' or 'humanized technologies'.[414] International monetary agencies and Western governments, as chief financiers of major projects in the so called Least Developed Countries (LDCs), sought to go back to the drawing

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[410]See CSIR Built Environment Unit, *Appropriate Technologies in the water Sector in South Africa*(position paper), May (2008), p.6.

[411] Schumacher in Willoughby (1990),p.132.

[412] see USAID (1976), pp.11- 12 ;Thormann (1979) In Robinson (ed.), pp. 280-299

[413]Ibid.

[414]See Bookchin (1977), pp. 73-85; Fromm (1968)

board rethink their strategies of engagement so as to put value to their money and, at the same time, make observable progress.

The millions of investment in form of external currencies into water dams and treatment plants had failed to serve the intended purpose of instituting lifestyle changes and through cost-recovery mechanisms, raise enough revenue to qualify the projects as sound investments. Municipalities were faced with growing populations juxtaposed against weak infrastructure systems and shrinking revenue collection. The attempt to redress the situation lend credence to AT turning it into a social movement at whose helm were optimists who saw responsive planning as that which is anchored in the people as users and in which users are participants, innovators, tinkerers, thinkers, and mobilizers of resources rather than passive recipients of donor aid and foreign tools of production. Scholarship around AT suggests that 'appropriate technology' included the belief that human communities could have a hand in deciding what their future would be like, and that the choice of tools and techniques was an important part of it. It further included the recognition that technologies could embody cultural biases and sometimes have political and distributional effects that went far beyond a strictly economic valuation.[415]

Appropriate technology became an important international phenomenon in a climate of despair in most countries of the Global South who were reeling from the shackles of failing economies as earlier emphasized. As Whitcombe and Carr (1982) note, the London-based ITDG Limited conducted a survey whose results showed that the number of institutions in the world that were operating under the rubric of 'appropriate technology' had grown from a handful in the early 1970s to over five hundred by 1977 and with an estimate of about one thousand by 1980.[416] As earlier observed, appropriate technology was noted to differ from the other kind of technology by being labour intensive, accessible to users readily, frugal of scarce resources, un-intrusive on the natural ambience, and manageable by the individual or small groups. Futurists cited

[415] CSIR Built Environment Unit, *Appropriate Technologies in the water Sector in South Africa*(Position Paper), May 2008, p.12.

[416] Whitcombe and Carr (1982), p.2,

the experience of the US, stating that one of the key advantages of AT was that it could be an effective way of shifting to advanced technology.[417]

Though AT was seen as promising, Anthony, citing Anderson (1985), cautions that scale, complexity and expense are not always positively correlated. It is possible for a large machine to be both simple and cheap and for a small one to be highly complex and expensive.[418]Anthony acknowledges that appropriate technology may have been practised for many generations in the past, but there was something new about it in the context of the AT movement of the 1970s. To him, appropriate technology had evolved into a developmental approach that aimed at tackling community development problems.[419] Viewed as such, appropriate technology did not have to be seen simply as some identifiable technical device; rather, it was an approach to community development that consisted of a body of knowledge, techniques, and an underlying philosophy.[420] Whether that philosophy is what Schumacher calls 'small is beautiful' or what I may refer to as 'small works too', AT's proponents firmly contended that it was important to realize that the use of 'appropriate technology' did not imply turning the clock back to the 18th and 19th centuries. Concomitantly, they believed in it being a complete systems approach to development that is both self-adaptive and dynamic, because as its users become wealthier and more skilled, they can both afford and use more expensive technical means.[421]

Though this line of thought clearly sees indigenous technology as emerging out of poverty, AT considerations became the cornerstone of the 1970s and later planning and social service provisioning in the Global South. This was financed and driven by international development agencies at whose forefront was the World Bank and a plethora of NGOs.

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[417] Hazeltine and Bull (1999)

[418]Anderson (19850), pp. 57-77.

[419]Akubue (2000), p. 5.

[420]Ibid.

[421]Dunn (1978) in Akubue (2000), p. 12.

6.3 Appropriate versus inappropriate technologies for water and sanitation in Nairobi

To discern what appropriate technology as a movement means, it is important to reflect on its 'inappropriateness'. The greatest indictment of the post-WWII approach to development, which not only reified Western technology, but also placed greater belief in large technical systems as drivers of rapid growth, was its failure to meet the aspirations of the users. Many projects to which millions of dollars had been committed and spent became mere monuments, with little socio-economic return if any at all. This question of inappropriateness, therefore, can be summed up as follows:

> Inappropriateness of technology may be reflected in the severity of unforeseen side effects, or by the gradual (undesirable) change in the dynamics and structures over time of a society through its dependence upon technology. The inappropriateness of technology might stem from its being deployed in a context quite different to that for which it was designed, or it might be manifested in the harmful effects of technology upon one class of people. Technology might even be inappropriate for the specific purposes for which it was designed due to the technical incompetence of the designer or the inability to effectively relate technical parameters to the real world of practice.[422]

Arguably, it followed that the popular centralized model of water provisioning and sanitation system outlays had failed to supply and empty wastewater for the Global South cities that were burgeoning with both internal and immigrant populations. The deputy director general of the Royal Norwegian Ministry of Development Corporation cited technological inappropriateness as being economic, social, institutionaland purely technical in nature, and that no other sector could provide so many examples of inappropriate technology as the water and sanitation sector.[423] The discussion around technology and development was more pronounced amongst professionals, especially within multilateral agencies involved in identifying and implementing various development projects in the Global South. The disconnect was always between popular westernized approaches plus the millions that came with instituting the grand projects

[422]Willoughby (1990), pp.18-19.

[423]Holmsen (1988) in Gamser(ed.)(1988), pp.26-35.

and the local realities that were threatening to get out of hand as time lapsed and cities found themselves constrained in terms of resources. Global health institutions were not only concerned with substantial supplies of domestic water and the cities' ejection of their waste water but also the question of safety of such in the face of increasing environmental pollution.

The rationale for centralized and networked systems of water supply and sanitation since the time of the great world civilizations and their augmentation in industrial age Europe and North America was to improve health and prevent epidemics, yet the systems, as observed by major scholarship, often became health hazards in themselves.[424] The management and provision of water and sanitation services was under the auspices of municipal councils within highly autocratic political regimes. Despite the shortage of personnel and duplication of roles under government ministries and departments, most of the municipalities could not afford the cost of maintaining pipes and treating the effluents. Leaking systems accounted greatly for non-revenue water while water scarcity saw the city further sink into what was becoming an urban health crisis. Wasteful practices have for long been associated with water use, sometimes making water a lifestyle issue that requires behavioural interventionist measures on its usage. In industrialized countries as well as 'developing' countries, it has been estimated that there is often a difference of between 30%and 50% between the water delivered into a system and the amount paid for by consumers, partly because of leaking pipes and partly due to faulty meters.[425] The large networks seemed to presuppose a supply of water that was often not there, hence rendering them as highly inappropriate.[426] In spite of these failures, the symbolism attached to these technologies as a result of the hubris and the reification that accompanied them saw them remain favourable to the minority urban dwellers in the upper middle class group and above. It ison the fringes of the networked city that subsidiary systems emerge from below. The appropriate technology paradigm purported to focus more on such forgotten or marginalized urban landscapes as sites for innovation and inventiveness.

[424]See MarikenVaa and NordiskaAfrikainstitutet.Research report no.94, 1993, p.12.

[425]Kalbernmatten and Middleton (1991), p.28.

[426]See MarikenVaa and NordiskaAfrikainstitutet, research report no.94, 1993, p.12.

In *Drawers of Water,* White, Bradley and White studied systems of water use and their improvement in East Africa.[427] The authors gave an in-depth account of the water sources, the amounts used and the ensuing costs in energy and time to households in a variety of environments. Their major finding was that nine out of ten households, both urban and rural, at that time in the history of these nations, drew their water from sources outside their house and carried it home. As a follow up, their appraisal of the costs of different types of improvements and the evaluation of the relationship between water quality, water quantityand the health of users provided no economic basis for providing each household with purified and piped water. The attention, thus, shifted to aspects of how to desirably improve the supply systems that existed in relation to their costs and offsetting gains, and, further, to asking about the kind of improvement that would be acceptable and preferable for the users. User-focused approaches became an acknowledged norm if not a practicable enterprise.

The United Nations took cognizance of the challenges of water and, resulting from the 1977 Mar del Plata (Argentina) International Water Conference, various undertakings were made to secure water. It was the first deliberate intergovernmental conference dedicated to finding solutions to water problems and applying them at national, regional, and international level in order to improve the social conditions of humankind, especially in the South.[428]Based on the deliberations in Vancouver and Mar de Plata, the UN General Assembly declared the period 1981 to 1990 as the International Drinking Water Supply and Sanitation Decade (IDWSSD), setting the very ambitious goal of ensuring universal access to good quality drinking water and adequate sanitation. The debate on appropriate technology shaped up greatly within this framework. The question of inappropriate technology and that of uncoordinated interventions had been singled out and efforts were made by the major agencies to cooperate towards achieving the decade's goal. Through WHO, UNDP, UNICEF and the World Bank, the Inter-Agency Decades Steering Committee that had been formed in 1978 was able to meet semi-annually to review the joint strategies. The committee

[427]See White, Bradley and White (2002); also see *Bulletin of the World Health Organization*,(2002), 80(1), (1973), p. 63.

[428] Hassan (u.d) UNESCO.

also set up various subcommittees through which it pursued more specific objectives of making the decade's key goal jointly attainable.[429]

The decade saw consultation and cooperation at a scale never witnessed before and, through conferences at both national and international levels, avenues for shared experiences and dissemination of knowledge were created. Eventually, the consultations transformed into what came to be known as the Collaborative Council of External Support Agencies (ESAs), comprising both representatives of multilateral and bilateral agencies and non-governmental organizations (NGOs). Its overall objective was to '… accelerate provision of water supply and sanitation services to all, with emphasis on the un-served rural and peri-urban poor, by using coordinated programme approach.'[430] However, the irony of this approach is its presupposition that solutions to the scarcity that faced most of the populations in the South would be solved through coordinated financing and collaborative planning with national and local players. As long as the financial institutions continued to wield financial power, appropriate technology would continue to be another miscalculated approach. The idea ought to have been to place technology choice in the hands of the local people through enabling environments void of the competition with western technologies that continue to cement social differentiation. It was no surprise, therefore,that appropriate technology was associated with the poor.

Despite the criticism, the momentum created by AT as a movement and the concerted effort from the global development agencies saw several research activities undertaken and a number of projects initiated. However, a closer analysis of Nairobi in the 1970s reveals the continued institutionalization of large water and sanitation projects. The World Bank, the African Development Bank, the European Investment Bankand the Japanese OECF partnered to finance the construction of the Thika Dam and the associated pipeline and water treatment plant. This was a paradox since the AT debate had indicted continued investment in large projects ashad been the practice of the 1940s onwards. The criticality and obduracy of the water problem in Nairobi perhaps made it difficult to encourage 'small approaches' to provisioning as concerted efforts were

[429] See MarikenVaa and NordiskaAfrikainstitutet, research report no.94, (1993), pp.27-29.

[430] Ibid.

adopted as a matter of importance against the backdrop of population explosion projections. At the inception of the Thika Dam, the city began to rely exclusively on surface water by closing down the last wellfield used for piped water. Perhaps at the inception of the Thika Dam, it was imagined that Nairobi would be a water-sufficient city, as such beliefs were a characteristic of such large-scale projects. With little improvement to the fast aging colonial infrastructure for Nairobi, it was foolhardy to expect Nairobi to become water secure. The lack of s culture of repair and maintenance meant that the problem of non-accounted-for water persisted, which complicated the issue of water sustainability for a city such as Nairobi.

In the context of changing approaches to technology choice, the water sector in Kenya underwent an administrative overhaul. In 1974, the Ministry of Water was created. Prior to that, the implementation of a few existing water supplies, which mainly covered the urban areas, had been conducted by a small department in the Ministry of Agriculture. The majority of Kenya in the rural and peri-urban poor settlements had been left to depend solely on non-piped modes of supply, which constituted river and spring sources. During the rainy season, harnessing rainwater would be affected too, with rainwater being considered safe for drinking if collected from clean corrugated iron roofs. This was before massive pollution threatened these small-scale non-networked sources of supply.

The Ministry of Water found itself with the responsibility of conserving, constructing and developing, as well as operating and maintaining, water supplies (except for the five major municipal councils led by Nairobi that enjoyed autonomy), sewerage facilities and pollution control of all water resources in the country, which included securing the catchment areas, key to which is the Aberdare ranges where Nairobi draws almost 90% of its piped water supply.[431]The National Water Conservation and Pipeline Corporation was also established. Its responsibility entailed borrowing funds from whichever source was deemed viable for various projects under its responsibility. Part of these responsibilities included supplying water in bulk to water under-takers, as specified by the government and the water board. The absurdity of having a corporation hitched on solicited funds in the face of a continued lack of decision-

[431]See G.o.K, 30 KANU Great Years: 1960-1990, Nairobi.

making power on requisite and appropriate technology choices exposed the institutions further to the moribund state that had characterized most government agencies in the postcolonial period.

Another development in the context of administrative reforms in the water sector for Kenya was the establishment of the research division in the ministry. Its key responsibilities entailed revising the existing design criteria for water supply and sewerage as a way of contributing to the technical knowledge essential for such undertakings. Further, it was to help synthesize hydrological and hydro-meteorological data and inform about the rational utilization and protection of water resources. Last but not least, the Kenya Water Training Institute that was founded back in 1970 had grown into a large institution that played a crucial role in equipping young people with the technical skills necessary for employment by the Ministry for Water, parastatals, local authorities and the private sector.

6.3.1 Nairobi Sewerage and Groundwater Survey Report of 1975

The World Bank instituted a survey for the status of Nairobi's ground water sources, with the aim of providing a basis for action due to the diminishing levels of water security and safety for the city. A special technical study was undertaken and a report prepared for WHO, which was acting as the executing agency for UNDP. The report noted that by 1975, the conservation area of Nairobi contained approximately 330 boreholes scattered throughout the area. Of these, 225 boreholes were privately used at an average extraction of 5,700 gpd/borehole. The rest of the boreholes were for public and industrial use, and they produced water at a rate of 33,000gpd/borehole for public use and 16,500 gpd/borehole for industrial usage. These figures were derived from another report, by J. F. Geita, titled '*Some Aspects of Groundwater of Nairobi'*. The general deduction from the report was that most private boreholes were being operated at much lower extraction rates than public and industrial boreholes. This meant that an assumption that a certain number of private boreholes could be operated at higher extraction rates could be made. However, what would be the institutional and organizational challenges for this?

Further, it was noted that by the period referred to in the report, there was awareness that approximately 30 to 40 boreholes had been abandoned, yet some of them were in such a condition that they could be restored. The implication of this was that it was possible to bring them back to production as a viable means of facing the existing challenge of water shortage for Nairobians.

On an optimistic note, the report saw the large number of boreholes that were abandoned or being operated under their full capacity as representing an investment that was not fully utilized. A rough estimate of an increase of about 15,000 gpd over 225 private boreholes would add approximately £3.5 million (sterling) to the city's water supply. Despite all ofthese proposals centring on boreholes, it was not certain whether the shortage that prevailed in the water supply for Nairobi by 1975 would be alleviated through ground water extraction. Hydrological surveys had proven that groundwater in the Nairobi area was generally good except for the fluoride content, which had been marked as sometimes high and varying from borehole to borehole.

Despite the optimism over the potential of a groundwater approach as a means of supply for Nairobi, increased extraction from existing boreholes was earmarked as being probably more attractive than the drilling of new boreholes. Perhaps this was in recognition of the increasing costs of procuring drilling services and conservational concerns in terms of the ecological balance.

As for sewerage, a similar study to the one conducted for water revealed that out of the total population for Nairobi in 1974, 60% or about 460,000 people were projected to be connected to the sewerage system by 1975. The remaining 40%, it was believed, would be served by septic tanks, cesspools and bucket latrines. In a few cases, pit latrines would be used. In 1976, the World Bank undertook another research project on appropriate technology for water supply and waste disposal in 'developing' countries. Emphasis was put on sanitation and reclamation technologies, particularly as they are affected by water service levels and by the ability and willingness to pay on the part of the project beneficiaries.[432]Although efforts were aimed at linking development to the

[432]See Kalbermatten, DeAnne and Gunnerson(1980) World Bank Report.

bottom, user participation centredless on incorporating local knowhow in making informed, workableand affordable technology choices.

Perhaps the notable development from the appropriate technology rhetoric and the reversal in the mode of engagement was the increased attention paid to sanitary matters. Despite it being an open fact that a water supply had to be coupled with a system of getting rid of wastewater, most Global South cities had continued to give sanitation a wide berth. While many donors were willing to invest heavily in huge water supply systems, none was willing to develop sewer systems. The period from 1974 saw more surveys being instituted in Nairobi to assess its sanitary situation. The main sewers serving the city included the Mathare Valley trunk sewer, which discharged to a temporary pumping station that pumped the wastewater to the Kariobangi sewerage treatment works. However, it was noted that the temporary pumps were too small and their layout unsuitable, hence, making the station un-operational. In some parts of Eastleigh, the majority of the houses had not been connected to the trunk line. This resulted in wastewater from these houses being discharged into open drains that posed massive health risks. The owners of the houses wererequired to connect in accordance to the Nairobi City by-laws.[433] What the authorities failed to appreciate in such a situation is that the mode of instituting the centralized sewer system in itself created the problem as it heaped the cost of connectivity on the individual.

A technical study conducted in 1974 noted that the quality of the sewers laid at the time was rather poor and that efforts had to be made almost immediately to improve the quality of the pipe material. In the same year, it was noted that there were thirteen sewerage treatment plants in Nairobi, of which six were waste stabilization ponds. The Nairobi Airport stabilization ponds had first been created in 1959 and were intended to run parallel with an existing overloaded surface aeration plant. However, it was necessary soon after commissioning the ponds to close down the aeration plant and the ponds quickly became overloaded. A new primary pond was added, the original ones becoming secondary and tertiary ponds. At certain times in the subsequent years, the records of which are not available, the ponds were operated as two parallel primary ponds with a small common secondary pond. There was no equipment for measuring

[433] KNA, ref. no. k.628NAI, (1974-1975).

influent or effluent flows. The ponds had been designed using a classification guide borrowed from South Africa on the basis of the climatic similarities between the two countries; however, the question was how efficient such designs were for a fast growing city such as Nairobi.

In addressing the issue of sanitation, the Nairobi City Council built another pond in Karen to serve a proposed high density-housing scheme and, by 1974, only phase one of the projects had been completed. The General Service Unit stabilization pond was built to serve the Kenya police's GSU unit on site. As part of taking responsibility for its waste, the Kenya Breweries Limited (KBL) had built a stabilization pond to deal with spent grain liquors and discharge from a bottle washing plant. Some minor ponds were also set up in 1972 at the PostOffice training school. The St.Thomas Aquinas and Industrial Area sewage treatment works were constructed too using the same South African technology as it had been used for the GSU and Karen plants.

Even though Nairobi of the 1970s witnessed developments in the expansion of its sewer lines, one key characteristic to note is that most of the mentioned sewer trunk lines connected major institutions and government offices. Despite planned on-site service schemes and other pre-planned housing projects, most Nairobi residents were left to their own means. When one could not connect to the mainlines due to the high costs of connection, septic tanks and cesspools became popular and almost synonymous with thesanitation systems for Nairobi. Deprived and informal areas like Kibera and Mathare continued to rely on pit-latrines if not open defecation. This had a negative impact on the sources of surface and shallow ground water supply and, as a result, they became a health risk. Rivers increasingly became polluted as more and more space for sinking pit-latrines shrunk due to the increased influx of people into the city, and this ushered in the squalor that was the hallmark ofsuch informal spaces.

As established through oral interviews, due to pollution, there was a major cholera outbreak in Kibera and other places in the mid-1970s. Though oral sources rarely give us specific dates, the epidemic warranted the reluctant government to extend the water supply pipeline slightly into the informal area especially to most structure owners who could afford a connection and sell it to their tenants. One lady recounted the moment

and from her conversation, as it is the norm in most African cultures to preserve historical events in memory by calling them certain names, the pipeline into the Kibera and other informal areas earned the name 'Maji ya Kipindupindu' which is the Swahili (local language's) word for 'cholera water'. [434] It was easy to connect the 'Kipindupindu' pipeline, as it was a stop-gap measure for the menace, prompted by the need to secure the population even for the future. This, thus, increased accessibility as more and more people put up water kiosks and standpipes.

As poverty increased tremendously in the 1970s and diminished the role of the state in providing social services, informal settlement areas ballooned to alarming levels compared to non-existent systems of water and sanitation. Where the government was absent, people as users continued to find their own means of provisioning, key of which was access through water vending. As Jean PierréGoubert states, water vending and the use of water kiosks is as old as civilization itself. Even when France was receiving its first household connections, water fountains that had been key providers of water persisted and society clung to the old.[435] Water vending through pushcarts became a key system of supply alongside standpipes and kiosks.

However, as most informants stated, faced with scarcity, poor neighbourhoods witnessed multiple forms of usage by which water was categorized according to the quality of its source. While river water would be used for washing clothes and bathing, well or borehole water would be used for cooking,while tap water purchased either from a central point or from mobile vendors would be used for cooking. Storage also becomes a key component of water usage due to unreliable sources. The inability to break the hardpan and dig deep pit-latrines as a result of topographical factors meant that the construction of pit-latrines involved raising them a few metres from the ground and whenever it rained, one side of the raised walls would be opened for the raw sewer to be carried away through open drains into the river.

One other important aspect to note is that appropriate technology debates for most of the Global South focused more on sanitary efforts. Several pit latrine designs were

[434] Mohamed Oman (not his real name) O.I, 31/07/2016, Kibera, Nairobi.

[435] Goubert (1989)

drawn to take care of the local realities. Where water was available, pour-flush toilets that incorporated socio-cultural components were built. Terms like Ventilated Improved Pit-latrines (VIP), Ventilated Improved Double Pit Latrines (VIDP) and Reed Odorless Earth Closets (ROECS) emerged to connote different designs that sought to employ local expertise and materials for their set up. Despite these attempts at designing sanitary systems that had an indigenous touch and incorporated the locals, for the high density urban poor settlements, the question of available space for such construction was a big challenge.

A study by John M. Kalbermatten and his colleagues, *Appropriate Technology for Water and Sanitation: A Planner's Guide* (1980) noted that specific designs were recommended in particularfor sanitation which had emerged to receive centre-stage attention. Despite the acknowledgement that planning had to be context specific, all ofthese efforts by trying to universalize the technical aspects of sanitation provision fell into the same trap of previous years, where expert groups assumed the primary role of planning for the poor. How the new technological choices were being effected remained delinked from the bottom, and poor coordination meant that most of the proposed projects did not go beyond the pilot stage. Scaling up remained a challenge to attain universal access.

Under such pressure, made worse by the biting poverty, open defecation and the carrying of nightsoil through the bucket system thrived in most informal areas of Nairobi. Communal (shared) pit-latrines were utilized but their being unattended mostlymeant that their efficiency in reducing health hazards was very low. In some cases, they werehealth hazards as they became overwhelmed by the huge number of people that relied on them and the failure to empty them, either through the lack of requisite technology or no one taking responsibility to manage them. Some structure owners prioritized providing the pit-latrines as a way of attracting tenants and justifying the high rents charged for very poor housing. This demonstrates how sanitation was not only a matter of human hygienic and health necessity, it had also become an instrument of power aimed at mediating between structure owners and their tenants. One other aspect noted from the field research carried out was the presence of on-site landlords who lived among their tenants and the existence of absentee landlords, mostly

speculators. ‘Landlords’ who lived amongst their tenants sought to provide water (at a fee) and dug pit-latrines and bathrooms to be shared by their tenants. One such incident involves a ‘landlord’ in Kibera who, while digging a pit-latrine, hit water. The pit-latrine was abandoned and it became a shallow well that serves him and his tenants to date, supplementing other means of supply.[436]

All in all, the 1970s and beyond, apart from augmenting the role of international players in the water and sanitation sector for the South, including cities like Nairobi, the appropriate technology momentum tended to fizzle out with time, partly because of the criticism levelled against it as either patronizing or promoting poor technology to maintain the statusquo in North-South relations. The introduction of Structural Adjustment Programmes (SAPs) in themselves made the situation in the South very complex for smallholdings and technologies to thrive. The tendency for innovators to become almost exclusively oriented towards generic, turnkey technological solutions was advantageous in being disseminated easily through a diffusionist approach, it tended to eclipse critical local development contexts and goals.[437] The assumptions (low capital investment, small scale, simple design) on which appropriate technology was anchored could easily become its own constraint, especially with explosive population growth, which put a strain on available resources. Appropriate technologies, as a consequence, struggled to induce broader innovation dynamics and capabilities beyond the solution to basic needs and specific production problems.[438]

Despite the dwindling opportunities for mainstreaming, small technologies or rather appropriate technology as a movement had served to raise ideas about technology whose influence would manifest in most sustainable innovations of today. Whether in housing, energy, food processing, mobility, light manufacturing or other domains, innovations that were now finding a niche had roots in appropriate technology.[439] In addition, the principles of public participation and a people-centredapproach to

[436] Oral Interview, Bw. Musa (real name):08/08/2016, Kibera.

[437] Smith *et al*. (2013), pp.1-11

[438]Ibid, p.6.

[439]See Kaplinsky (2010), pp.193-203; Smith et al. (2013), p.6.

development continued to inform governance and planning into the 1990scourtesy of the AT debate.[440]

Furthermore, the debate set the stage for understanding technology from a social constructivist point of view, which not only spurred tremendous gains in STS studies but informed development planning today in seeing technology as more than mere artefacts. One of the greatest experiences with the Appropriate Technology movement was the fact that technologies are socially constructed, as demonstrated by De Laet and Mol through their explanation of the success of the Zimbabwe water pump. The working of a specific technology must be comprehended beyond its technical terms and be seen to contain embedded beliefs and value systems of the society within which it functions; hence, contextual analysis is required.[441]

Looking back to the water and sanitation status against the backdrop of the appropriate technology debate, it is necessary to note that despite international agencies consolidating their position in the social lives of most Global South economies, AT managed to prioritize water and sanitation issues. The declaration of the *Water and Sanitation Decade(1981-1990)* helped put into perspective key aspects that would inform provisioning for the years that followed and, at the same time, set a precedent for concerted efforts being made to progressively attain growth in the referred-to sectors. The 1980s were dominated by policy approaches that promoted supply-driven programmes, with the state being recognized as central in providing water and sanitation services. Planning remained 'top-down' and the major weakness of the approach was the laying of much emphasis on the hardware component of provision that prioritized water, hence, leaving sanitation lagging behind. The 1990s coming on the heels of SAPs and their neo-liberal ideology would reduce the state to a facilitator rather than a provider. Where did this paradigm shift in the provision leave the urban underclass that occupied the fringes of the 'networked city'?

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[440]See Pieterse (1998), p.343-373.

[441]De Laet and Mol (2000

6.4 Governance, Political Pluralism and Flexibility: Off-grid provisioning practices and reforms

Nairobi as the capital city of Kenya was the melting pot for political agitation for pluralism. The attempted military coup of 1982 had witnessed the government institute a *de jure* single-party state characterized by autocratic governance. There was little space for divergent ideas to thrive. The state controlled most aspects of human life and for urban areas like Nairobi, this meant little people participation. The 1980s to the 1990s witnessed a lull in localized initiatives and over-reliance on institutions like the World Bank and other western donor agencies spearheading planning and service provision. As such, external ideals continued to be imprinted on the local landscape.

The 1992 Dublin Conference on Water and the Environment encouraged the privatization of the water sector in the Global South countries. It declared that water has an economic value and must be treated as an economic good. It also stated that access to water and sanitation at affordable prices was a fundamental human right. The fourth principle of the Dublin Declaration states:

> Water has an economic value in all its competing uses and should be recognized as an economic asset. Following this principle, it is especially crucial to recognize the basic right of all human beings to have access to drinking water and sanitation at an affordable price. Past failure to recognize the economic value of water led to wastage and to uses that were harmful to the environment. To manage water as an economic asset is an important path to the achievement of efficient and equitable use; and to the encouragement of the conservation and protection of water resources.[442]

This set in motion a process of commercialization and privatization of the water and sanitation resources in Kenya. Commercialization is defined as the transformation of a public body into a private company with public capital[443] or, contextually, as 'a form of privatisation which entails establishing and registering of water and sanitation

[442]Petrella (2001), p. 66

[443]Jaglin (2000)

companies owned wholly by local authorities'.[444] As a concept, this was not new as it had been effected in Britain decades earlier with mixed results. The neo-liberal ideology in water and sanitation was centred more on the belief in the superiority of the markets in allocating resources and the claim that interactions with nature were best served by a market economy and a liberal international order. The perception that the problems witnessed in the social service sector were caused by government failure, through corruption and malpractices or despotic control, greatly informed the push for the commercialization and privatisation of public utilities.[445]

With the centrality ofinternational players in determining the course of things, countries such as Kenya, by virtue of being signatories to international conventions, the Dublin Declaration being one of them, had to embrace the popular neo-liberal ideals of the 1990s and set into motion reforms geared towards being facilitators rather than providers of key infrastructure services, with water and sanitation being a target. Facilitated and financed by the German Agency for Technical Co-operation (GTZ), the German Bank of Reconstruction (KFW) and the Urban Water and Sanitation Management (UWASAM) Project, the commercialisation process was set in motion with the goal of decentralising water services and providing services at a cost that was economically sound and one that would be sustainable investmentwise. The piloting of the project involved the commercialisation of water and sewerage services for three municipal councils in Kenya, namely, Nakuru, Eldoret and Nyeri.

Benchmarking involved taking study tours to Zambia in1995 and Malawi in 1996 to learn from others,[446] and holding several workshops and conferences to agree on the roadmap towardsfull privatisation, which had a legal component that had to be drafted and adopted in parliament. From such tours and boardroom deliberations, efforts to develop a new water and sanitation policy for Nairobi and the rest of Kenya were set in motion. However, a closer analysis points to such efforts having been dictated by the liberal norms of commercialization and privatisation, with a focus being put on managerial and administrative restructuring. The model of private company

[444]UNCHS-Habitat (1998)

[445] see Hassan (undated) UNESCO, p.82

[446]See K'Akumu (2006)

management seemed to be a zero-sum game in these concerted efforts as little or no investment targeted overhauling the almost century-old technical artefacts of supply.

Nairobi's water and sanitation status meanwhile remained dire and alarmingly in crisis. The reliable water yield from its existing resources (Kikuyu, Ruiru, Sasumua, and the intake from Chania) was rated as 207,000m^3 per day. Later on, the commissioning of the Thika Dam in 1996 did not meet the water deficit but increased the water supply for Nairobi. The supply link was divided into two distinct operating areas centred on major service reservoir complexes at Kabete and Gigiri, handling supplies of 82,700m^3/day and 809,700m^3/day respectively.[447]

The mushrooming of informal settlements towards the end of the 1980s and in the first half of the 1990s continued to pile pressure on the water and sanitation resources for Nairobi. The poor economics and the post-election conflicts of the multi-party era had pushed more and more people into the city, leading to a mushrooming of informal settlements. By 1994, 55% of the population of Nairobi lived in informal settlements, sitting on only 6% of the entire city's land, and only 12% of plots in these settlements had piped water.[448] In 1998, a report released for the NCC on water leakage and improvement on the distribution system noted that approximately 930,000 people were connected to the NCC water supply, hence leaving an estimated population of 1,050,034 relying on other sources.

The report exposed the inability of the water system to meet the demand and noted that this deficiency was more due to institutional issues than any lack of technical capabilities or manpower available.[449] One of the major highlights of the failures was the soaring percentage of unaccounted for or non-revenue water, which stood at 52%.[450] The mushrooming of slums basically as a result of a melting economy and political turmoil would witness several illegal connections and leakages. These lowered the pressure in the system, leading to the problem of water flow. The crisis in sanitation saw the emergence of what popularly became to be known as 'flying toilets', which

[447]Nyanchaga (2016)

[448]UN-Habitat, (2003)

[449] NCC, (1998)

[450]UN-Habitat (2003)

involved defecating in a polythene bag and hurling it into either limited open space or onto a roof. This in itself was dehumanizing but yet it remained an option to many households, especially where basic services were completely absent. It is this menace that saw many NGOs and CBOs regroup to provide shared/communal toilets in most informal settlements and the emergence of concepts like ECOSAN toilets amongst others as technological interventions to the crisis.

Debates bringing together various players in the water and sanitation sector characterized the late 1990s, with an emergence of private-public partnerships. This effort culminated in the Water Act 2002 and the creation of the Nairobi Water and Sewerage Company in 2003, whose agenda was improving the supply network to make water flow steadily for the already connected and accessible for the deprived bulk of the city residents.

The inception of the Water Act of 2002 aimed at professionalizing water provision in Nairobi and it served as the last step towards water commodification. Through a new organizational structure for managing water resources and privatizing water utilities, the stage had been set for a system that was ready to meet its opportunity costs. The Nairobi City Water and Sewarage Company (NCWSC) was formed in 2003. More private players had come on board to supply water and enhance accessibility. Today, the company is at the centre of water provision, enjoying a monopoly administratively within the framework established by the Water Act of 2002. Furthermore, embedding water as a basic human right under Chapter Four (the bill of rights) of Kenya's new constitution 2010 changed the urban water dynamics.

But despite these achievements on paper, in practice, the Nairobi City Water and Sewerage Company's (NCWSC) network coverage has remained limited in supplying water to all city residents. The inadequacy of the company's system can partly be explained by the aging and dilapidated infrastructure network inherited from the previous water regimes dating to colonial days, and continued planning and engineering practice based on 'modern infrastructure ideals' rather than being informed by local-based realities. Since the initial layout of a centralized water infrastructure, there has not only been minimal expansion of the existing networks to unserved areas, but also a

poor repair and maintenance record for the installed works by the company's water engineers. Currently, only 50% of Nairobi's residents have access to piped water, with the rest obtaining water from kiosks, vendors, illegal connections and boreholes.[451]

Coupled with the burden of rapid urbanization under resource constraints, it is clear that the NCWSC is unable to cope with the water demand of the burgeoning population. Beyond the technical issue of the inadequate network expansion, the challenges that are now bedevilling NWSC appear to be more on the management side, with the question of the (re)integration ofthese non-connected areas remaining. This means going beyond the dominant paradigm of the network to create a new way to extend the service to all.

6.4.1 The Prospects of Universalized Provisioning and the Technological Dilemma for the Urban-Poor: Small is beautiful

6.4.1.1 Water kiosks versus formalization of small-scale water provisioning approaches

In 2015, it was estimated that only 40% out of the 50% connected households had a continuous or regular water supply.[452] What this implies is that a majority of Nairobi residents, both 'connected and unconnected',have to think beyond the network for provisioning. Water vending and the use of water kiosks are not a phenomenon of the 20th or 21st centuries. As such, they have remained as one of the most enduring imprints of the issue of water supply.[453] However, there has been a serious upsurge in their adoption, especially for 'informal' settlements and the middle income areas that are mostly targeted for water rationing by most Global South water providers.

The centrality of kiosks has seen the utility company, NCWSC, adopt them for supplying informal areas. This has been motivated by the ratification of water as a basic human right in the 2010 Kenyan constitution, in its demanding that it be enjoyed equally. One way of achieving this is through increased access and by penetrating the

[451] https://www.nairobiwater.co.ke/about.html, accessed on 21/11/2015.

[452] Ibid.

[453] See Goubert(1986)

areas that the city has treated as blind spots through a localized communal access model via water kiosks in itself represents recognition of how these small technologies of provision complement the key or large infrastructures that reach only a fraction of the city, being deployed along class lines. In the absence of network connections, forces from below, comprising neighbourhood groups – sometimes of 'a militia nature' that take advantage of governance vacuums in most informal areas[454] –and other players 'fill the gaps' from below. Some of these include the standpipes, water kiosks, push or pull carts, boreholes and shallow wells. While kiosks imply continuity and the persistence of the analogy of 'going for water', vending through push/pull carts and human porters becomes an essential link between the sources and users (households).[455]

Over time, what started as 'illegal' connections of water became the key supply networks, easy to reinstall even when uprooted by the water company. In tandem with the 2002 Water Act and the 2010 constitution, NCWSC has established the Informal Settlement Department through local level partnerships for organized regulated and improved supply. Through these efforts, NCWSC has made an 18-km extension of its network to cover residents in parts of Kibera (Mashimoni), Mathare 3A and Mathare 3B, amongst other informal settlements, as a way of enabling improved access for over 200,000 residents.[456] This was enabled through what has been established as the Water Services Trust Fund as a proactive kitty aimed at anchoring the financing of water provisioning services to underserviced areas of Kenya.

The rationale for implementation brought on board Pamoja-Trust, a local-level non-governmental organization working in informal areas towards community capacity building and local-level participation. It has a long-standing reputation in initiating bottom-up approaches to service provision amongst the urban poor of Nairobi through community mobilization and partnership with international and state actors.[457]Pamoja-Trust prior to this had provided formalized connections to the key storage tanks and standpipe points, which ensured that the poor residents accessed water regularly and at a relatively moderate fee away from the exploitation by cartels. However, water cartels

[454] See Akallah (2012)(unpublished MA thesis)

[455]See Abdulmaliq (2004)

[456]http://waterfund.go.ke/index.php?option=com_content&view=featured&Itemid=435 accessed 21/11/2015

[457]http://www.pamojatrust.org/ accessed 21/11/2015

and other private suppliers targeted their connections and storage tanks with vandalism and sabotage attacks so as to maximize their profits by eliminating the competition. [458] Currently, NCWSC is up-scaling this approach in the mid-level settlements. While the main interest is to increase coverage for low-income groups by employing mid-level technology, it must also be seen through the lens of maximizing revenue by eliminating illegal connections.

To improve access to water and sanitation for informal settlements, specifically Kibera, the slum-upgrading programme prioritized the housing that came along with networked pipe supply and trunk sewer lines. For example, as part of the KENSUP programme, NWSC under the Kibera Water and Sanitation Project (K-WATSAN), which received funding jointly from G.o.K and UN-Habitat, provided a water supply network to eight community blocks within the villages in Kibera.[459] Each block consisted of nine water kiosks, an overhead water storage tank, a communal bathroom and a toilet facility. The laying of major sewerage pipe that cut through the informal settlement enhances the evacuation of faecal matter and other forms of waterborne waste from the ablution blocks.

By virtue of NCWSC lacking administrative capability within informal areas, it partnered with a local NGO (Maji naUfanisi Kibera) to implement a programme of ensuring community mobilization and a participation component as a means of ensuring a people-centred approach. The technical design component of the toilets basically involves the pour-flush design due to low water pressure and regularized usage through water-saving means. Kjellen tackles the questions of the cost of water and states that public kiosks are a safeguard measure as the government should guarantee water services to the poor and regulate any private sector involvement in water services. Private operators should supplement rather than substitute the public sector in water provisioning, especially for the poor urban residents.

[458] Oral Interviews, John Juma (not his real name), 07/09/2016, Mashimoni (Kibera) Nairobi, Kenya.

[459] UN-Habitat (2008)

6.4.1.2 Small-scale independent water suppliers

The informal areas of the water scape in Nairobi have historically been treated as blind or blankspots on the city planning maps, and have become a melting pot for the bottom-up approaches that serve to complement rather than replace the centralized networks, which basically operate along the boundary of such settlements. Existing in non-serviced or underserviced spaces, small scale low level initiatives have been undertaken either at an individual or communal level to fill the gap left by state and other major actors in the mainstream infrastructure sector. Small-scale suppliers of water come in the form of fixed-point water providers and portable or mobile suppliers. Fixed-point vending in Nairobi has a long history, from the first colonial standpipes strategically located on the fringes of the African-settled areas that were mostly characterized as informal due to their lack of tenure and owner-vending, whereby some peopleconnected to the city municipal mains decided to sell water in standardized jelicans (formerly debes) and kiosk supply systems operated by different groups connected legally or illegally to municipal mains. Those with private boreholes have also been in the business of selling water to their neighbours or motorized vendors and pushcart operators. For a long time, water has been characterized as a 'free gift of nature',worth sharing and freely accessible. This cultural and religious connotation in a way provided a platform for communalized provisioning, especially in deprived settlements.

As for the mobile or portable suppliers, oral interviewees in Kibera pointed towards the use of trucks as early as in the 1940s, locally made wheelbarrows and push/pull carts. They either deliver water to the users as close as possible or do household deliveries based on the road network. The difference between fixed-point supply and mobile providers manifests itself in the cost as door to door deliveries and motorized supply charge higher fees compared to the user covering a distance to 'go for water'.

While the centralized system as defined by a pipe network employs rates easily deductible from the metering system, mobile vending and fixed standpipe supplies have seen a standardized evolution of the debe (the metallic container reused from being a commercial oil carrier) to the modern day 20-litre plastic jelican that is used as a

standard measure of value. It costs between 2 and 5 Kshsduring regular supply, but this can rise as much as 60 Kshsduring periods of scarcity.[460]

Drawing the line between housing and supply mechanisms, informal settlements exhibit temporality in the construction of houses and congestion on unsecured tenure of land. As such, they have precarious systems and as much as their mode of supply follows the same temporality through use of cheap materials, it exposes the poor residents to contamination, especially when the dominant open-drains means of wastewater disposal prevails.

When it comes to the mobile or portable water supply means, they thrive best during scarcity or intermittent supply. Scarcity is sometimes artificially engineered by 'water cartels' as a way of cashing on the users. Mobile water suppliers source their water from NCWSC, standpipes, kiosks and boreholes. Motorized vendors and water bowsers serve individual homes in relatively high-end estates who suffer from water rationing and who refill their storage tanks for extended usage or high-rise buildings that are underserviced due to low pressure in the network or have been developed in under-serviced areas, for example, in the fast-growing residential estate of Pipelines to the southeast of Nairobi. Vendors and water bowsers also serve construction sites or buy in bulk and retail in informal settlements, institutions, restaurants and health facilities. Manually-pulled carts and porters serve almost the same clientele but, as might be expected, they dominate low-income areas, partly because of the convenience, the personalized networks or the cost implications.

To emphasize the ability of what begins as small or illegal and gradually gains legitimacy through acceptance and eventually is anchored as a major system of access, the NCWSC, adhering to the provisions of the 2010 Constitution, has entered into an arrangement that has seen these small-scale providers incorporated into the supply chain.

[460] Oral Interview, Michael Murume (not his real name), 31/08/2016, Lindi, Kibera, Nairobi.

Image 13: Private operators' metered connections to the mains

Source: Photo taken by this researcher at theLangáta Sub-County Commissioner's grounds

Standpipe and water kiosk operators receive water from the utility company at a subsidized cost and they reconnect their individual pipes, mostly ending up with a 'spaghetti outlay'. This venture attempts to regularize supply to informal areas as well as help the utility reduce the non-revenue water losses.

Thetacit partnership between the 'informal water operators' and NCWSC reinforces my argument that the bottom-up approach complements the large technical systems of supply that are hampered by either politics and the economics of provision or other embedded forms of differentiation. This has led to the registration of water and sewerage companies that are licensed to undertake the water supply through trucks and bowsers via the bottling and packaging of water. This partnership helps in regularizing supply and pricing for consumer protection. For small operators, the system of metered access helps the company to reduce non-accountable water and also ensure the quality of the water supplied.

6.4.1.3 Spaghettization in water provisioning for informal areas

Image 14: Individual and communal water operators

Source: takenin Kibera by this researcher. Itshows the pipe connections.

The image shows one of the water operators inspecting his line whichconnects to the NCWSC central metering section. The technology of supply used is simple to allow for an owner 'fix-it yourself' approach incase of leakages caused by vandalism by competitors, accidental breakages or 'tear and wear'. The influx of cheap PVC pipes in the Kenyan market since the mid-1990s has led to a high level of 'spaghettization', reducing the distance covered to 'get water' and the cost.

Before the rampant connection process, both legal and illegal, a community-based organization, Umoja wa Maji Safi, spearheaded the supply of water by negotiating with the city authorities and installing storage tanks that would be supplied with water at subsidized rates and allowed for resale to the residents. This association recorded tremendous success, but with liberalization came competition. One community operator through the association blamed water vendors for water shortages by claiming that they sabotage community projects of supply so as to exploit residents by selling at higher rates.[461] Apart from the water supply, such associations provided communal toilets that were connected to the main sewers, thus enhancing the sanitary situation in informal settlements.

[461] Oral Interview, Simon, Umoja Wamaji Safi member, 23/07/2016.

The 1990s, despite witnessing tremendous change in the administration and management of water resources, also initiated another movement of runaway connections that are popularly referred to as 'spaghetti connections'. The case of these forms of connection comes intothe limelight as a grassroots initiative that initially started as an illegal activity but later gained recognition and acceptance from the other players. The 1990s, despite witnessing the expansion and emergence of informal areas, also saw the emergence of militia gangs or neighbourhood/area boys who filled the governance vacuum in the informal areas that were being treated as blankspots by the city authorities.[462] The youth gangs established pseudo-systems of utility supply, working in cohorts with some corrupt utility companies' employees.

Facilitated by the emergence of cheap PVC pipes that required less expertise to fix and minimized the losses whenever uprooted by city authorities or vandalized by rival gangs, a network of pipes became visible, traversing open sewers and coiling along corridors in the congested settlements. Despite exposing the residents to an exorbitant cost of water (making poor people pay more for water than the metered serviced well-to-do residents),[463] these connections saved them the agony of walking for long distances in search of water and, sometimes,ensured a regular supply of water as they would be plugged into the water mains leading to important institutions or high-end residential areas where they knew the pipes never go dry. The intricate system became difficult to stop and, due to more participatory deliberations spearheaded by the Civil Society and Rights groups, NWSC found a middle ground in the early 2000s to systematically connect water operators through a centralized point from where they, as providers, were metered and allowed to run their own supply chain deeper into the informal settlements. Apart from providing some semblance in the systems of supply, making them a little secure from contamination, these corporations saw increased applications for connection, further improving water accessibility.

Through the field observation and surveys, it canbe argued that the high-level acceptance of the bottom-linked approaches witnessed for almost two decades has improved livelihoods and made informal areas liveable. Increased spaghettization has

[462] Akallah (2012)

[463] see Kjellen and Mcgranahan (2006)

not only made water accessible but initiated another system of sanitation through 'pay toilets'. Several women and youth groups saw the opportunity of earning income through providing waterborne sanitary services. Through partnerships with the World Bank, UN-Habitat, and other agencies focused on slum-upgrading programmes, major sewer lines were installed to cut across the settlements, allowing such decentralized systems of sanitation provision to plug in and provide the essential services at a relatively affordable cost. Mostly, the enterprises involved an integrated bathroom or shower and toilets. This has not only restored dignity to the residents but also has had a ripple effect in many other areas, including security (by offering former idle youths employment, hence keeping them away from crime) and a clean environment.[464]

6.4.1.4 Dreaming with flying water pipes: The SHOFCO story

Shining Hope for Communities (SHOFCO) is a local movement in Kibera, Nairobi, which is modelled on the principles of self-help and bringing hope to community through joint locally-based initiatives. Started in humble conditions by a young man, Kennedy Odede, through soccer as an instrument of social mobilization and later partnering with Jessica Posner Odede, SHOFCO has grown through leaps and bounds to emerge as one of the most transformative local-level non-profit making organizations. Though education for the girls and women remains their core objective, by mobilizing resources, SHOFCO reorganized itself to provide one of the most radical engineering ideas in water supply. The first visit that I made in March 2015 witnessed a steady integrated system of water supply, with secure connections from the NWSC despite the normal shortages that characterize water supply in most parts of Nairobi. With massive overhead water tanks raised onto towers that are visible from kilometres away, SHOFCO presents a case of technology thatcan be made relevant by embracing the realities of time and society. SHOFCO also had an automated card system that could be swiped to reveal important data on the consumption of various users and, sometimes, their consistency in accessing water from the various points. This in a way allowed for subsidized rates and, at the same time, ensured loyalty due to the various competing suppliers. The level of innovativeness exhibited through the appropriation of various services onsite at the user and provider level laid a strong foundation for a sustainable model of provision.

[464] Focus group Discussion, Makina Kibera, 10/08/2016.

Apart from having the massive storage tanks for water and running an integrated public toilets/bathrooms-biogas system (to be discussed later), SHOFCO had taken advantage of its prudent management capabilities and resource mobilization to have a borehole sunk. This in itself was very ambitious because Kibera as a site is known to be made up of a very rocky surface, having been a quarry and jungle at inception. All in all, adhering to all statutory requirements and going through the requisite tests, the borehole was successfully sunk. This was a deliberate measure to provide cheaper rates for water almost on a universal scale as the goal may expand to incorporate the entire Kibera area in the future. The most challenging task seemed to be that of laying the pipe system for pumping water to all their distant water kiosks and the units being operated under their management. The site had been attained through negotiation and a buy-out agreement of some structure owners. However, piping needed an innovative approach, with all the space occupied leaving only corridors that served as dirty footpaths and open sewers for waste.

It was at the moment of such a dilemma that the SHOFCO team dared to dream of the impossible by imagining an aerial system of water supply using electricity cables. This was no mean feat. As revealed through the conversations on site, this was a long-term goal, requiring maximum consultation with experts and community workers of all kinds. The most interesting thing is how the management took advantage of their organization, receiving many researchers to solicit professional advice of any kind on their envisioned project. Through sound mobilization expertise, SHOFCO not only won the admiration of local players but also attracted big corporations like the huge Kenyan Telecommunication Company, Safaricom, and famous individuals who were ready to partner with them. Hence, the would-be huge fees for consultation and materialswere easily secured. As a self-help social movement, SHOFCO aimed at harnessing local labour and materials where possible todeliver service to the communities they were serving at no or little cost.

It was, therefore, encouraging to witness the project officially kick off in October 2016.[465] The SHOFCO story became a story of bottom-linked approaches gaining viability, especially in environments where they were enabled to generate solutions they

[465]For more of an insight, see the launch at https://www.youtube.com/watch?v=aKMEwuuH2Pk

best understood suited their local environments. By understanding the dynamics of land tenure, the risk of surface piping systems getting contaminated, and, hence,the health hazards, the local needs and the threat of vandalism of water systems by rival water kiosk and standpipes providers, SHOFCO sought to exploit the aerial space, which involved no extra costs in the form of enticers and negotiated fees with structure owners. They, hence,drafted a system that would meet their social and organizational needs. At the moment, SHOFCO have exported their concept to other informal settlements in Nairobi, specifically Mathare where they are actively engaged.

6.4.1.5 Integrated water and sanitation systems: Umande Trust and the bio-centre concept

One of the other visible landmarks in most informal areas of Nairobi is the bio-centres. Umande Trust, a rights based agency, prides itself as a believer in modest resources being able to significantly improve access to water and sanitation services if financial resources are strategically invested in support of community-led plans and actions.[466] The Trust's underlying philosophy of ecological sanitation, as explained, is that if treated properly, human waste is a valuable resource. This is no new phenomenon ashuman and animal excreta were used in previous times and after the sanitary movement in Europe for fertilizer production.

To deal with the challenges of water supply and sanitation that compromised the health of informal areas and the city at large, the Athi Water Service Board (AWSB), which manages water resources in Nairobi, developed strategic guidelines to improve water and sanitation services in Nairobi's informal settlements (Kibera, Korogocho and Mukuru). The project was funded through the Nairobi Water and Sewerage Emergency Physical Investments Project (CKE 3005) – Package 4 Construction of Ablution Blocks in Informal Settlements in Nairobi. This was part of a funding agreement between the French Development Agency (AFD) and the Government of Kenya, titled 'Nairobi Water and Sewerage Emergency Physical Investments Programme (NWSEPIP)'. The project was financed by AFD through AWSB and the memorandum of Agreement (MoA) between AWSB and Umande Trust was signed on 6 August 2007. The bio-centres have improved water and sanitation in the area, contributing to the reduction of

[466]Binale (2012), p.1

related problems and access costs while fostering cohesion in the community, among other benefits.[467]

Image 15: Ongoing construction of the dome shaped bio-digester

Source: Umande Trust, 2008

The bio-centre incorporated a lot of aspects that had informed the appropriate technology debate of the 1970s by using local skills and incorporating social components at all stages, where people were not only trained but were made to participate in the actual construction and running of the centres. By incorporating a business model that allows members to charge subsidized fees for the bathrooms facilities and cooking gas, members were able to meet the operational costs and earn livelihoods for themselves. The social hall at the top allows for community meetings, promoting coherence, solidarity and corporation as important grassroot aspects of citizenship representation and mobilization. The bio-centres being coordinated and instituted through partnerships with major stakeholders has allowed for the provision of

[467]Ibid.

a piped water supply system to the site by NCWSC, enhancing coverage, access and affordability to the users of such facilities.

Image 16: Grassroot participation at the technical and social levels

Source: Umande Trust, 2008

Though brilliantly conceived and implemented, this approach has not been up-scaled to cover wider areas. Perhaps the positive side of it is how other NGOs and community organizations, such as the SHOFCO, as discussed above, were able to borrow and incorporate this model in their approach, not only to provide water points and sanitation facilities but also to harness cooking gas to supplement their energy requirements in their school feeding programmes.

Image 17 Complete dome shaped structure with toilets and bathrooms, gas chamber/cooking area and social hall (upper floor)

Source: Umande Trust, 2011.

6.4.1.6 Pit-latrine emptors: The big and small of sanitation in informal areas

The ground in Kibera does not allow for pit-latrines to be dug beyond six feet in depth. This had been revealed in a major studied carried by the colonial government in the 1920s as it grappled with what it called the 'Kibera problem'.[468] This is not only the case in Kibera. Most of the informal settlements have the one major characteristic of being mostly uninhabitable zones, such as abandoned quarry fields. The construction of pit-latrines, where they really existed, thus had to be done innovatively by raising them a few metres from the ground and sometimes having mechanisms for emptying into open drains during heavy rainfall on one side and, at the same time, allowing for handemptying. However, it is the congestion in such areas that makes it difficult for emptying. While partners like UNDP and the World Bank thought of providing tractors to help in dealing with this situation, a group of local people have re-organized

[468] Akallah (2012)

themselves by mounting a metallic oil-drum on a two wheel cart tiny enough to circumvent the narrow alleys that litter most informal settlements. The tractor would mean a very long pipe, and wastherefore inefficient,and alsomight not have been able to deal with clogged latrines due to dumping of non-biodegradable materials in the pits.

The operators interviewed cited mixed materials finding their way into most pit-latrines, making hand emptying the most efficient approach as sorting can be done to facilitate removal of excreta. Having worked for over twenty years, the hand-emptors are widely known and their services are easily procured from a common site where they hang out when not contracted. While dumping of the raw excreta can be a challenge that can easily pose a threat to the rivers where they would probably be dumped, partnership with other agencies has allowed for coordinated working between city authorities and these operators. They take the excreta to a centralized site where it is taken over by the city authorities for treatment. This clearly reinforces the notion of devolved systems working seamlessly with centralized networks to attain a formidable equilibrium rather than a conflictual interaction between the large and small, and the formal and informal, amongst other binaries. Furthermore, it clearly demonstrates Abdou Malique Simone's thesis of 'people as infrastructure'[469] since these small-scale operators have cemented themselves as an integral part of the day-to-day lived experiences of the residents of informal settlements in Nairobi.

[469]Simone (2004), pp.407-429.

Images18: Motorized exhauster versus pushcart emptor

Photo by researcher: hand-pulled pit-latrine emptying

Photo by researcher: UNDP/World Bank funded sanitation/septic tank/toilet exhauster

6.5 Revisiting Localised Technological Approaches

To see 'small technologies' simply as a non-departure or reversal of a nostalgic past becomes more of an acknowledgement of its centrality to development in terms of improved livelihoods and ecological balance, with large technologies being seen as pervasive and destructive to the environment. Appropriate technology and current (small and localised) technology as suggested by Harvard professor, Harvey Brooks, are complementary rather than mutually exclusive, and the potential benefits of both would be greatly enhanced when the two were made to co-exist.[470] Of importance is the understanding that alongside the co-existence of the large and small, the contemporary and the old, the sophisticated and the simple or the imported and the indigene, appropriate technology in itself represented a heterogeneous set of social and technical options rather than a homogeneous phenomenon, and the best choices between the alternatives were based on the objectives to be accomplished and the possible human and environmental effects.[471]

It is utterly unrealistic to describe any technology that enhances the capacity to satisfy community goals and aspirations as inefficient.[472] Rather than paying attention to the product, the emphasis should be on the process of how tools mediate between humans and the attainment of their needs for sustenance. Such a process, of course, is loaded with socio-cultural and political connotations. Hence, many technologies fail not because of their innate qualities of the material or system being implemented, but because of the way they are introduced into local situations.[473] In the same realm, where technologies travel into new territories and along other frontiers, the attention should be on the methods of transfer and the new zones as contested spaces. Incoming technologies in themselves are also contestable, with choice being an integral quality of any technology, large or small.

By technology concentrating on non-human factors, it remains divorced from the realities of the communities where it is applied and expected to serve. People have to be anchored at the centre of any process of technology transfer and in the production

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[470] Brooks (1980)

[471] Akubue (2000), p.8.

[472] CSIR Built Environment Unit, *Appropriate Technologies in the water Sector in South Africa* (Position Paper), May 2008, p.3

[473] Ibid.

cycle. Putting everything in perspective, it is justifiable to observe that, away from the emphasis on a 'quantum leap' kind of economic planning that is externally driven, local people have to be allowed to operate on a trajectory that recognizes 'self-organization' by utilizing indigenous skills, local materials and personal innovative skills, and, through small groups, pursue a path in which they co-exist as assets in the system of provisioning. They must be seen as co-producers, but more than co-producers also. Whether reactive or proactive, the appropriateness of technology must be context specific not just as an approach but also as an outcome deriving from below. The power of people to understand their problems better and self-organize towards providing localized solutions to their daily challenges cannot be downplayed in the face of the trumped-up ability and efficiency of grand projects. Different players in technology development and transfer determine the 'soft' and 'hard' component of the resultant artefacts, and how this manifests itself at a social level is what determines its appropriateness.

Concurrently, disbursement based on annual budgetary allocations easily becomes an end in itself as pursued by the implementers and not the responders to the needs, capabilities and the participation of the recipients or those to whom the various projects are purported to serve.[474] There is greater authority wielded by consultants and contractors in defining which problems and how they ought to be solved. With such power enjoyed by virtue of the prominence of scientific expertise and 'best practice', the choice made is heavily pegged on technical competence and business interests.[475] As such, there may be little incentive to look for appropriate technology in a wider sense, but, rather, a tendency to stick to technical solutions that are known, without going into what those solutions embody or presuppose in the way of institutional arrangements or users' preferences.[476] In the end, the external agenda and interests result in the exclusion of the end users, contrary to the general goal and vision of the projects in the first place.

[474]See MarikenVaa and NordiskaAfrikainstitutet, research report no.94, (1993).

[475]See Gran (1985)

[476]Ibid.

6.6 Which way Forward: Hybridity or Exclusivity?

Contemporary water practices in Nairobi demonstrate that contrary to the widely agreed argument of public utilities not serving informally developed areas (seen as legitimizing illegal settlements), NCWSC is actively increasing its water supply to informal settlements across the city. As already mentioned, the water sector in Kenya has undergone various institutional regimes, with the current policies recognizing pro-poor approaches that emphasize every citizen's right to safe and clean water supply. This constitutional right gave NCWSC the impetus to form the informal settlements department to execute its mandate accordingly. Under the new department, water engineers have acknowledged the inadequacy of a purely engineering approach in water supply.[477] The department employed a team of sociologists to work on the social components of servicing informal settlements. The Mathare and Kibera cases demonstrate how NCWSC worked closely with locally-based NGOs in gaining ground support for the water kiosk projects while, at the same time, understanding the dynamics of supplying such settlements with water. Here, NCWSC drew important lessons that are relevant for servicing low-income groups outside engineering knowledge.

Given the inadequacies of the utility's piped water to reach every household, water kiosks can be a viable alternative, which NCWSC can use to improve access to water supply to low-income groups. Rather than insisting on individual household connections as envisioned by the universal aspects of the networked infrastructure, NCWSC can still achieve 'water for all' through pipe-fed kiosks. This is a practical solution, especially for servicing low-income settlements where the laying of water infrastructure in the conventional way may be difficult due to dense settlements that may call for the demolition of structures and relocation processes, have complex land tenure issues, and have cost implications. This complex picture, present across the informal settlements of Nairobi, further, does not hold for a networked infrastructure model, which presupposes a properly planned city providing guidelines on infrastructure layout. Instead of a 'plan-service infrastructure-build-occupy' development model, Nairobi's development pattern depicts the reverse, where residents first occupy and build before the planning and provision of infrastructure is done.

[477] Nairobi Water and Sewerage Company, (2009).

Aware of such realities, NWSC in the meantime cannot wish informal settlements away when close to 55% of Nairobi's resident live in such areas.[478]The utility company has, therefore, had to revise its approach to water supply if it is to live up to its mandate of serving all residents living in Nairobi.

Nairobi's water supply involves a complex mesh of actors with varied interests. Whereas the literature on 'modern infrastructure ideals' point to a monopolistic infrastructure supply, the case of Nairobi water supply presents us with an array of actors, ranging from the public utility (NCWSC), NGOs and CBOs to self-help community groups, individual vendors and privately-registeredsmall-scale water operators. The increased number of actors in the water sector has reconfigured the traditional centralized supply mode to include varied technologies in producing and distributing water to city residents. The drilling of boreholes and use of motorized trucks or manual-driven carts and bicycles to deliver water to unserviced areas and the overt reliance on fragmented sanitation systems of the same nature have become a predominant practice in various parts of Nairobi. This leads us to yet another related argument of consumers as passive receivers of services. On the other hand, many of NCWSC's customers are dissatisfied with the water and sanitation supply service, resorting to alternatives of digging boreholes and tapping into the water vending business or constructing septic tanks, cesspools or pit-latrines that are exhausted either by tractors or handheld/pulled appliances. As for the interests involved, whereas NCWSC's target is to reduce unaccounted-for water, build revenue base and reduce illegal connections through water kiosks in informal settlement, water vendors' interest rest in maximizing business opportunities through profit making and earning a livelihood. The liberalizing of the water sector has meant that water is commodified and, as an economic good, water attracts interest from private market actors. It can be said that the current thriving of small-scale water supplies is a manifestation of operationalizing the commercialization policy, as provided by the Water Act of 2002.

Despite the critical role that water vendors play in servicing areas cut off from the utility company's water, their operations often come with considerable consequential effects on water supply. For instance, vendors are seen as exploiters, –charging high

[478] UN-Habitat (2014)

prices for low quality water. While water prices at public kiosks are highly subsidized for the sake of public interest through a non-revenue water policy, private vendors overcharge for their services, with the poor bearing the brunt. Private vendors' sources of water often raise questions, linking them to illegal tapping of the utility company's mains. On the other hand, borehole water vendors submit applications for the drilling and operation of boreholes, but testing of the water quality is only done at the commissioning stage, with no subsequent testing. In as much as boreholes offer a reliable supply of water compared to those dependent on the utility's supply, borehole vendors tend to charge higher prices to take advantage of their reliability. Recognizing the potential role performed by private vendors offers an opportunity for the NCWSC to regulate the water price and quality in a collaborative approach.

6.6 Chapter Conclusion

The relative failure of the water network and sanitation infrastructure in Nairobi can partly be explained by the legacies of the colonial engineering, which, in itself, contained elements of spatial segregation of the city based on race and were never conceived to attain egalitarianism within the urban spaces. Until today, major engineering efforts have been oriented towards increasing the water supply offerby tapping water from distant catchment areas and believing in networked household wastewater evacuation through large technical systems in the direct continuity of colonial engineering.

With the challenges of rapid urbanization and a lack of resources, the centralized approach actualized through the LTSs comes short in terms of water supply networks expansion, leaving one part of the city unconnected and reproducing the inequalities of the past. AS during the colonial times, the skewed water connectivity and supply by the NCWSC has left many residents living beyond the networks, depending on alternative water supply systems. Even among those living in areas connected to the central system, the unreliability of the system for delivering water all the time, partly due to extended water rationing and system breakdown, has forced residents to seek external alternatives in supplementing the utility's water supply. The same goes for deficient wastewater removal mechanisms, leaving the majority of the populace to adopt devolved systems that are context specific, such as septic tanks for low-density

settlements and communal washrooms for congested informal areas. The growing reinforcement of these other non-networked systems in everyday practices presents an opportunity for leaving the old colonial engineering practices and building an innovative model that could universalize the service provisioning to all citizens. Rather than sticking exclusively to a network supply approach, NCWSC has recently opened an informal settlement department to adapt to the realities of the city, and the engineering practices seem to be embracing new rationales in moving towards a more demand approach, which is currently leading to the implementation of decentralized options, such as water vendors and water kiosks, with a sustainable diminution of the water consumption. This path, which recognizes the complementary role played by variegated or decentralized modalities of water and sanitation provisioning, offers a real opportunity to build a new water and sanitation regime for universalizing the right to social services for all citizens in Nairobi beyond the network paradigm.

CHAPTER SEVEN

CONCLUSION

7.1 Introduction

While it is overly ambitious and herculean to imagine that a history of over a hundred years of the development and evolution of Nairobi's water and sanitation infrastructure system can be unravelled in one thesis, I undertook this move with the aim of unbundling the large technical systems of supply and the multi-faceted process of appropriation which acknowledge bottom-linked technological shifts. Global South urban spaces present mixed narratives that for long have either disappeared or continue to be suppressed by the methodological and theoretical approaches that treat the South as lacking agency or incapable of progress. As a way of 'worlding'[479]Global South studies of technology, I questioned how provisioning for water and sanitation has been mapped out in Nairobi since its foundation in 1899, with the goal of producing narratives of the daily experiences of the users. Seeing colonialism and urbanity as contested processes[480] informed this undertaking, not only as a way of filling the historiographical gap that exists in the history of technology in Africa but also as an effort at de-bracketing Global South histories of urbanization. For this purpose, this study walked the thin line between addressing the theoretical and empirical concerns concurrently in developing a history of technology responsive to the Global South, especially Africa, and being anchored in what is considered today as global scholarship (for example, Global HOT). Before I draw the key conclusions deriving from this study, it is important to revisit some of the lingering theoretical aspects of inclusive global scholarship which the history of technology (HOT) cannot escape. This is important as a way of setting the right backdrop against which to unravel emerging issues within the Global Southas unique and equally relative to the North, and as intertwined histories and topographies of both regional and global processes of development.

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[479]*'Worlding'*is borrowed from the aspect of *'Provincialising Europe'* advanced by Chakrabarty (2000) to encompass the efforts aimed at complicating scholarship by challenging the assumed universality of theories derived from experiences in the North. See Ananya Roy in Oldfield and Parnell (2014), p.9 andKooy and Furlong (2017), p.4.

[480]Bigon(2012) and Arnold (2005); see also Fourchard (2011), pp. 223-248.

7.2 Revisiting Theoretical Aspects in the Global South Studies

This study was informed by David Arnold's call for a shift towards a history of technology that focuses on *use*, *effects* and *meaning* so as to capture the experiences of the Global South without privileging the North.[481] David Egerton's *The Shock of the Old* (2007) and his ideas of *creole technologies* provided reference points, even when not conspicuously visible in the thesis, as it addresses not only users' agency but also unbundles centralized large technical systems as ubiquitous imprints. From the advent of colonialism to date, large technical systems of supply more often than not continue to co-exist harmoniously or in conflict with indigenous technological ideas, ideals or artefacts. Alongside many authors whose primary concern has been to lend a voice to the Global South, theoretical questions which help mediate the achievement of this end abound. From Thomas Hughes' 'seamless web' metaphor, which alludes to the inseparable connections among technical, social, and economic aspects of large scale technological systems, to John Law's 'heterogeneous engineering', which provides an extensive way of talking about the interactions among the technical, social, political and economic dimensions of engineering work,[482] many talking points have emerged to witness a shift from *technological determinism* to a SCOT analysis, which acknowledges the centrality of context in understanding the invention and innovation of technology and the need to see technical artefacts as socio-culturally constructed.

Acknowledging this progress in the history of technology and other technology-related studies, Hecht in *The Radiance of France* (2009) observes that a loose consensus has developed around the notion that technology, politicsand culture are mutually constitutive. However, by and large, the history of technology and its disciplinary cousins – as she refers to other sociological studies – have expended considerably more energy on the construction of technology than on the construction of culture or politics.[483] Though it is understandable that the fear of relapsing into technological determinism or reified and hubristic representations of technology have led scholars to use culture primarily as an explanatory factor, what has preoccupied studies of the history of technology, the foundation for this study has been the relationship between

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[481] Arnold (2005), p.87

[482] See Law's essays in Bijker et al. (1987) and in Pinch and Law (1992), as cited in Hecht (2009), p. 39

[483] Hecht (2009), p.40

politics, technology and culture. The assumption here is that political, social, and cultural choices shape the design and growth of technical artefacts and systems.[484] Moreover, technical artefacts and the process of appropriation, especially of incoming technologies, must be understood as non-neutral and users as not just mere passive recipients. The technological and spatial patchwork or collage that manifests itself in cities like Nairobi – as demonstrated throughout this work by the multiplicity and 'decentred' modalities of provisioning for water and sanitation – has to be understood away from the conventional technological determinism perspective or Daniel Headrick's '*Tools of Empire'* narrative. But it must also visualize technological processes as multi-lineal and heterogeneously constituted.

In locating and localizing Global South studies, the idea, as Michelle Kooyand Kathryn Furlong argue, is not to draw a line between 'North' and 'South' as distinct categories to be theorized independently. The South, like all spaces, is relational and exists through a complex network of connections that are always unstable.[485] Clapperton Chakanetsa Mavhunga draws attention to the inadequacy of conventional (Western) STS at redressing itself to non-Western contexts. The explanation is that while STS in traditional practice is good at identifying banal forms of science and technology, it is severely limited in the Global South societies in which the black and white of things that are technological and scientific are not or may not be readily recognizable.[486] The binary of North and South that is presented asymmetrically by being skewed towards the North ordinarily distorts both theory and practice by 'treating places outside the Anglo-American (read as Euro-American) heartland as sources of data rather than sites for theorization in their right'.[487] Even though when reading Mavhunga, whom I categorize as one of the leading African scholars with special interest to STS, one feels a strong urge to adopt an Africanist approach to technology studies, yet this may lead to writing revisionist history or falling into the trap of the colonial historiographers as has often happened with nationalist African historiography. In challenging the 'neo-colonial narrative about Africa', Murunga envisions the need to invert the old model of

[484]See Hughes (1983), MacKenzie(1990), Noble (1984), Pinch and Law (1992), and Bijkeret al. (1987), as cited in Hecht (2009), p.40.

[485]Comaroff and Comaroff(2012) and Mabin(2014) in Kooy and Furlong (2017), p.4.

[486]Mavhunga (2017), p. xi

[487] Parnell and Robinson (2012), p. 596 in Kooy and Furlong (2017).

North-South and construct new forms of knowledge that encompass ordinary people's daily experiences.[488] In recognition of this, I see the acknowledgement of the cyclic nature of movement and transfer of knowledge as more informative as long as the Global South locations are viewed as historical rather than ahistorical, and that they exist as active sites for knowledge production rather than passive recipients of the Western 'development, modernity and progress'.

Our concern should not be about addressing Africa and the entire Global South as special sites but about the historicity and particularities of these spaces.[489] For example, despite Nairobi being uniquely a city in East Africa that is replete with local histories, it cannot be understood extensively without acknowledging its connection to the British imperial histories and the configurations of the entire commonwealth of nations. It is against this backdrop that this thesis explores interconnectedness as manifested by the complementarity argument that conspicuously arises as we follow in the footprints of Nairobi's urbanity and its water and sanitation technological scapeof both centralized and 'decentred' technologies of provision and access. By questioning existing historical trajectories and the general scholarship on urbanity, technology and society in Africa, this study sought to locate the ordinary people's agency in infrastructural developments as localized processes. In doing so, it addressed itself to the interaction between conventional or popular engineering models of social service provisioning and the shifts from below, especially in 'informal spaces'. The greatest deduction that informed most arguments is that 'neglected spaces' that represent informality are fertile spots for invention and interstices of innovation, technological flash points and nodes of technological divergence. As demonstrated throughout the thesis, it is not possible to deduce the question of either/or in terms of dominant systems of provision, as what emanates is the co-existence of multiple technologies to give us a quilted 'techno-spatial' topology.

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[488] Godwin Murunga in an Interview with Desmond Davies, Ghana News Agency, London Bureaux, *(http://www.ghananewsagency.org/world/council-head-challenges-neo-colonial-narrative-about-africa--114445)* Published: 2017-03-17 16:17:43

[489] Myers(2011)

Nairobi, like any city in the world, has its urban materialities embodying aspirations of various actors, but, historically, its engineer sociologists continued to define both the characteristics of the technical artefact and the social universe in which they were to function.[490] As a colonial city and asan urban space, Nairobi is loaded with imprints of social differentiation, social control and domination and the post-colony has seen elitist ideals foment themselves in parallel with a rapidly expanding group of urban poor. However, much as infrastructure supply has for several years followed a variegated path, this study sought to push the boundaries beyond asymmetries of race and the haves versus the have-nots, or legitimate residents versus 'vagabonds or deplorables', amongst many other social characterizations. As cities not only in the South but also in the North witness the emergence of unprecedented infrastructures which are not owned by government or large businesses, away from the centralized or controlled top-down by government or industry, instead they become owned and developed by individual citizens or small businesses. Yet they manage to mushroom into local, regional and even global infrastructures.[491] What then does the historicizing and particularization of Nairobi's water and sanitation infrastructure reveal to us as we move towards global HOT?

7.3 Key Discussion Points and Reflections

7.3.1 Socio-Spatial Appropriation and Technological Representations

Most technologies of water and sanitation are either interconnected to land use patterns or their utilization is impacted by spatial dynamics. In the colonial context, land was central to the patterns of urbanity and the social security of certain urban residents. Nairobi, as explained in this thesis, developed from scratch, rising from a simple railway depot to the metropolis it is today. However, as we grapple with questions of technologies of social service supply and access, the key discussion that arises is how spatial appropriation dynamics have not only shaped urban (Nairobi's) history but how the technological scape is shaped by the same socio-spatial processes of urban development. It is impossible to explore the sanitary and water-provisioning question in most urban areas without revisiting how land as a factor is socio-politically reconstituted.

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[490]See Brain (1994), p. 218

[491]See Egyedi, Mehos and Vree (2012)

Nairobi in its first two decades of development grew organically with the arrival of the railroad in 1899.[492] This *ad hoc* nature by which Nairobi existed was a major impediment to infrastructure planning, especially when based on land concessions.[493] The proponents of the 'networked city ideal' espouse a system of interconnected nodes through built infrastructures that are highly centralized in terms of how they are governed and managed. This 'modern' ideal presupposes a spatially and socially ubiquitous, top-down governed infrastructure system which provides exclusive and homogenous services across the city.[494] But it is important to note how this 'modern infrastructural ideal' casts infrastructures as public goods, whose construction, use, and maintenance and extension are closely connected with the land use regulationsof the state.[495] These infrastructures embody technical networks for the supply of urban services that are 'blackboxed' and hidden in 'underground cities',[496] with the assumption that they are 'utterly fixed, hard technologies characterized by perfect order, completeness, immanence and internal homogeneity'.[497] One key characteristic of most built infrastructures, especially of the networked ideal, is their invisibility, which many times derives from the fact that most are laid underground. They only become visible when and where they fail. This notwithstanding, one thing that is clear is the centrality of land in shaping patterns of infrastructure systems access, whether buried underground or laid above ground. Land appropriation patterns that spatially represent and characterize the city put a mark on technological outlays, be they of a centralized and monolithic manner or 'decentred' and fragmented. Large technical systems govern in a top-down way and the 'small technologies' of provision that thrive on individual or communal efforts all coalesce to make heterogeneous imprints of urbanity. Most ideologies and theoretical discourses of technology studies underplay the spatial aspects that shape processes of invention, innovationdeployment, and adoption of technologies as artefacts of daily life. In writing this thesis, I endeavoured to point out how the urban technological scape is uniquely variegated in tandem with specific spatial and

[492]See Otisa (2005), pp.73-97.

[493]See Murunga (2012), pp.463-486.

[494]Coutard and Rutherford (2016), Egyedi and Mehos(2012)

[495] Graham and Marvin(2001)

[496] Graham (2010)

[497] Graham and Thrift (2007), p.10.

land expropriation patterns. I pushed beyond the conventional narratives of racially segregated cities and the over-emphasized informality question to locate the autonomous nature of technologies of provisioning, especially water and sanitation.

Retrospectively, much as the Global South has witnessed massive growth in contemporary urban studies that focus on infrastructure, the emergence of the 'splintering urbanism' hypothesis needs re-questioning. To this end, a number of works have emerged to challenge the attempt at positioning the urban infrastructural disaggregation as a recent phenomenon. Michelle Kooy and Karen Bakker use the Jakarta case to historically locate 'decentred' approaches to water access.[498]Meanwhile, Kooyand Furlong state that analyses of water supply in Southern cities that do not pay attention to processes beyond the network can obscure deep inequalities grounded in conditions of ecological vulnerability. They argue that looking beyond the network lends greater complexity to discussions of water's urbanization. These arguments are illustrated through the examples of the interacting flows of piped water, groundwater, wastewaterand floodwater in Jakarta. Although these cannot account for the fullness of water's urbanization, they demonstrate its importance beyond the network and the need for research in Southern urbanisms and in Urban Political Ecology (UPE) to engage seriously with networks that are not only multiple and unstable, but are constantly remaking and being remade through the intersections of inequality, technologyand ecology.[499] In the same way, Elizabeth Wamuchiru challenges the notion of 'the networked infrastructural ideal' by building a narrative of co-production and heterogeneity of technical systems of water supply in Nairobi.[500] However, juxtaposed against 'splintering urbanism' thesis, this work confirms the massive shifts towards multiple small-scale modalities of provision as a postcolonial phenomenon. It is with this understanding that I reverse the narrative by pointing out that the Global South cities and perhaps those of the North have traditionally been fragmented and 'splintered' in terms of their socio-technical topologies. Nairobi, for instance, is marked by a quilt of different socio-technical arrangement of water and sanitation provision that combine both top-down approaches that are characterized by highly

[498]Kooy and Bakker (2008), pp.1843-1858.

[499] Furlong and Kooy (2017), p.901.

[500]Wamuchiru(2017)

centralized municipal governance and bottom-linked modalities. These include shallow wells, bore-holes, rain-water-harvesting, cess-pits and pushcarts. There are also mediative hybridized arrangements, such as the 'spaghetti' pipes and standpipes cum water kiosks. The centrality of some of these methods from below, as espoused in this study, has witnessed a process of being streamlined and acknowledged by the utility companies, run from above, through public-private partnerships that combine the large and the small to plug into the technological gaps existing, especially in the informal settlements that are melting pots of both technological innovation and contestation. Heterogeneity and 'decentred' or devolved small-scale modalities of provision have been and will remain a permanent marker of most cities as their history goes hand in glove with that of the cities themselves. Nairobi's chequered sociotechnical outlay is as old as the city itself.

Wiebe E. Bijker, addressing the 'principle of symmetry' in sociotechnical explanations of technology in *Of Bicycles, Bakelites and Bulbs* (1995), states that one way of avoiding the twin horns of social and technical reductionism is to introduce other differentiations between explanandum and explanans, between dependent and independent variables, between foreground and background – differentiations that are not based on the distinction between the social and the technical.[501] This he refers to as 'the technological frame', which allows us to distinguish foregrounds and backdrops other than the technical and the social (or vice versa).[502]The stark topological variations manifest different narratives of technology and see the interfaces between the human and physical urban components as 'innovation junctions'.[503] Using the dominant paradigm of LTS as the departure point and seeking to locate technologies of water and sanitation from below, especially as experienced by ordinary citizens through their day to day livelihoods, this thesis approached technologies as embedded in social, economic and political norms or meanings and drew various effects from their usage that spur counter-productions in the form of hybrids, contestations or the persistency of the indigene. This not only leads to social reconfigurations but also reproduces techno-political and spatial definitions. It makes it possible to walk through different epochs of

[501] See also Law and Bijker (1992)

[502]Bijker(1995), pp.275-276.

[503]Wit et al (2002), p.50. See also Cowan in Bijker, Hughes and Pinch (1987), pp. 261-80

Nairobi's evolution, delineating the multiple narratives of technological obduracy and paucity, especially in water and sanitation, distinctly pointing out the shifts from the organic city of the pre- First World War period to the rational or planned city of post 1920 and the kind of socio-technical ramifications these changes had on the urban residents collectively and distinctively. Concomitantly, I analysed local developments by flipping the two sides of the coin, back and forth, unpacking the dominant global paradigms, such as the 'high-modernist ideals' and 'appropriate technology' rhetoric of the 1950s to the 1980s. This unfurled narratives that offer wider lenses of understanding both the social and political character of sociotechnical systems. Nairobi's water and sanitation scape, thus, emerges as a multilayered outlook which combines the visible and invisible components that emerge from an interaction of several actors key, being foreign ideologists and financiers as well as local decision makers, non-human actants and users (residents).

7.3.2 A Political History of Technology

It is common knowledge that colonialism in Africa as instituted by European powers at the close of the 19th century represented the worst form of racism. However, in analysing the evolution of key infrastructures, one needs to hesitate and refocus so as to approach the subject holistically rather than taking the much trodden but limiting bifurcated path of reducing everything to power and race relations. While colonialism thrived on notions of white supremacy that were atavistically justified by deep-seated Eurocentric ideals, infrastructure provision stretches further than race dictates. A survey of the development of Nairobi's water and sanitation infrastructurein a way that attempts to locate the race question beyond the normative interpretations, as attempted in this dissertation, opens more windows to critically understanding the all-roundedness of technology and, in this case, infrastructures of water and sanitation provision as artefacts functioning in socio-cultural and geopolitical milieus. The social contexts within which technology arises and functions encompass a system of tensions and controversies due to the contested natureboth of *things* and society at large. Whether protracted conflict rather than closure or consensus leads to sociotechnical stabilization is open for discussion.[504]

[504] See Hard (1993), Bijker (1995)

The theory of technological politics, as Winner states, draws attention to the momentum of large-scale sociotechnical systems, to the response of modern societies, to certain technological imperatives, and to the all too common signs of the adaptation of human ends to technical means. In so doing, it offers a novel framework of interpretation and explanation for some of the more puzzling patterns that have taken shape in and around the growth of modern material culture.[505] This approach proposes that we take artefacts seriously by paying attention to the characteristics of technical objects and the meaning of those characteristics.[506] While it was not the main goal to reproduce Winner's technological politics theory, in the contextual analysis of the large technical systems of water and sanitation for Nairobi and the bottoms-up representations of supply, this thesis affirms the notion of technological non-neutrality. Technical artefacts, be they small or big, are embedded in politics as they occur in a socially and economically contested milieu. The meanings and effects of these artefacts either point towards intended or unintended consequencesas they are appropriated, produced or co-produced. They become actants that visualize and represent socio-cultural constructs.

Gabrielle Hecht states that opening the black boxes of culture and technology simultaneously can, for example, give us an insight into how technologies constitute a terrain for transforming, enactingor protesting power relations within the social fabric. Taking politics and culture as objects of analysis greatly deepens our understanding of technological change.[507] This reinforces Winner's earlier observation on the importance of the technological politics approach not as a substitute but as a complementary theoretical perspective to the earlier conventional frameworks of analysis. In tandem with this approach, I undertook to retrospectively analyse the water and sanitation sphere for Nairobi both from above and below. This exercise does not witness a momentous departure from the technological narratives of infrastructures emerging in particular from Global South landscapes such as Kooy's Jakarta[508] or Kjellen's Dar es Salaam,[509] but it represents the historical particularities of Nairobi as both a settler and colonial city. The British imperialists in their colonization of Kenya were reluctant,

[505] Winner (1980), p.124.

[506] Ibid.

[507] Hecht (2009), p. 41

[508] Kooy, (2010, 2016)

[509] Kjellen (2000)

with Uganda having been their main 'jewel' in the East African region and, as Murunga notes, the first step towards the consolidation of political power was achieved through the establishment of centres like Nairobi with a rudimentary administrative system.[510]However, this process of consolidation proved an intractable challenge that was further exacerbated by controversies within the administration between settlersand by the fact that, unlike South Africa, Kenya 'was appropriated whole by a metropolitan power which wanted to control the region but did not have any clear notion in advance of what to do with it.'[511] This in itself led to Nairobi having a stuttered start by what its first colonial administrator, John Ainsworth (1864-1946), characterized as the lack of a definite scheme or layout and where '…things just moved on and were liable to alteration to suit some particular fad and fancy'.[512] How did this shape the infrastructure landscape and discourse of technologies of provision?

First and foremost, the adoption of a given technical system actually requires the creation and maintenance of a particular set of social conditions as the operating environment of that system.[513] The sanitarians led by Edwin Chadwick in 19th century England and Wales did not just campaign for the adoption of technical solutions to the miasmas through piped systems of water supply and waste water egestion from the cities. They went a notch higher in augmenting a highly centralized municipal system with strong policies through the adoption of the Metropolitan Sewers Act of 1848 that forbade the construction of houses without suitable drains and required them to be connected to public sewers provided there was one within 100 feet, thus echoing the provisions of the 1844 Metropolitan Buildings Act. For the first time in the history of the city, the commissioners (administrators) were given the authority to order that existing properties be connected to sewers. Lack of co-operation by the owner invited the commissioners executing the work themselves and passing a levy onto the owner.[514] It was this high centralization and power consolidation in management boards that Chadwick had envisioned in his report of 1842. This was founded on the belief that it was the only effective mechanism to deal with opposition from persons and groups with

[510] Murunga in Salm and Falola (2005), p.98-130.

[511] Brett (1973), p.166.

[512] Ainsworth memoirs in Maxon (1980),p.100, and Goldsmith (1955), p.52

[513] Winner (1980), p.130.

[514]Ibid.

vested interests and local rights campaigners. Hence, certain technologies can only function within certain specific politically-constituted environments as either authoritarian or democratic (liberal) and vice versa, where the technologies as non-neutral entities reproduce autocracy or democracy in governance. As for Nairobi, the non-defined colonial power structure meant that the city started to grow organically without clear guidelines and planning considerations.

However, the presence of the Kenya-Uganda railway corporation, not only as a fore-runner and founder of Nairobi in its 'modern' form but as a commercial entity with a clear internal chain of command – from Thomas Hughes' systems analogy – meant a parallel system that reproduced political and administrative duality. The corporation did not only exhibit stronger financial muscle necessary for supporting large technical urban set-ups, it almost monopolised the higher technical expertise from its pool of engineers and Asian (Indian) coolies attached to its regiment. This duality has been indicted for the haphazard and ad hoc nature in which Nairobi developed, plunging into major bubonic plague outbreaks in 1901/1902, 1904 and1906, and later in 1913. Despite the controversy that shrouds the Williams Commission of 1907 investigating Nairobi and senior politicians like Winston Churchill who gave the city a clean bill of health on its suitability as a site, questions abound on how to provide a panacea to the water paucity and the sanitary 'time bomb' that continued to tick alarmingly. Although Nairobi suffered a major fire outbreak in 1902 that razed most of the initial establishments, this dynamic hardly informs water infrastructure planning or atleast the debate around it as one would state for cities such as Hamburg in Germany, where planning for water coalesced around the quest not only for a sanitary city but also one that was secure from devastating fires. Of importance to note is how the plague epidemics changed the social landscape of Nairobi and introduced the initial semblance of racialized planning ideals. If people like Edwin Chadwick and Joseph Bazalgette left permanent imprints on London's sanitary landscape, in the colonies within the first two decades of the 20th century, it was a person such as W. J. Simpson who created the socio-technical milieu that would precipitate the water and sanitation systems alongside other key infrastructures. I say this on the understanding that the sweeping recommendations by these engineers or public health experts ended by having

widespread ripple effects on the socio-political and economic core of the emerging polities and their respective urban landscapes.

For instance, the 1913 plague outbreak in Nairobi was blamed yet again on the conditions of the buzzing Indian bazaar. This saw another commission headed by Professor W. J. Simpson being constituted by the Colonial Office to look into the sanitary matters bedevilling Nairobi.[515] Simpson was an experienced health officer who had worked in many colonies, including India. Specifically, he had been the head of the sanitary commission in Accra in 1909 and alsoin Lagos. The Colonial Office hence saw his reputation as vital in unravelling the persistent problem of the plague that was threatening one of the rapidly emerging nodes for their East African interests. Going by what Simpson had recommended for Accra in the Gold Coast (Ghana), it came as no surprise when he recommended racial segregation as one of the health policies for Nairobi. He had strongly argued against the indigenous water access methods that had thrived in Accra, racially terming them as primitive, and placed the responsibility of providing WSS infrastructure for 'natives' on the white man, categorically stating that this was his burden.[516] It is such sentiments that reinforced the over-emphasis on large centralized systems of infrastructure in nascent cities such as Nairobi.Anchored on the principles of separated settlements and the belief in centralized systems as a panacea to the public health challenges in urban areas, Simpson's *Nairobi sanitary Report of 1913* legitimised the call for the removal of the Indian bazaar. His further recommendation that a system of compulsory connection of houses with sewers be effected –seemingly reproducing Chadwick's 1842 *Report on the Sanitary Condition of the Labouring Classes of Great Britain* – alienated the urban underclass that could not afford such measures. Political scientist John Dryzek,in what he sees as a system of 'administrative rationalism',described the process of harnessing scientific expertise by administrators to solve environmental problems.[517] As such, it is a process that is politicised, is full of controversies and is one likely to be contested. The Simpson Report advanced 'rationalised' racial segregation in how Nairobi was spatially appropriated. However,

[515] White, Silberman and Anderson, (1948).

[516]Bohman (2010)

[517]Dryzek (1997)

does the skewed nature of infrastructure access and supply imply racialized provisioning or what has been characterised as 'spatial apartheid'?[518]

To effect Simpson's vision for Nairobi, a certain political structure reminiscent of post-1842 Britain had to be created. Municipalization along Joseph Chamberlain's 'civic gospel' ideals wasset in motion with the Municipal Corporations Ordinance of 1922.[519] This sets in motion the purchase of all water supply infrastructure assets from the railway corporation, marking the end to its close to two decades management of water infrastructure alongside the colonial governments' inadequate sanitary system. Furthermore, the Muthaiga water company that had operated from 1911 as the first private water company in Kenya was also acquired. With the Water Act of 1952, the Nairobi City Council gained sweeping powers and sought to be declared as the sole water undertaker. This obsession with monolithic systems of supply and centralized urban governance modes must be seen as having thrived within a strong-handed colonial regime and perpetuated in the postcolony by the powerful single-party states that emerge in most former colonial metropolises. However, this attempt at attaining technological determinism and urban social re-engineering through technologies of supply, despite becoming the dominant imprint of 'modernism' or 'westernization' that constitutes the urban-scape, was met with either forms of protests, contestations, the persistency of the old as evidenced by the continued reliance on ground water modes of supply in the form of wells and bore-holes,or the emergence of hybridized systems that emerged to complement the 'networked' municipal mains supply systems.

Secondly, going back to the question of how the colonial consolidation of power and how politics of domination, subjugation and subversion shape the technological discourse in the urban South, notions of travelling technical ideals and binaries of the old versus the new, the 'modern versus indigene' or 'big versus small' have to be delineated to provide insights into the non-seamless web of technology appropriation. Mikael Hård, inexploring the ideal of conflict and consensus in technology, warns that a functionalist methodology or approach can never succeed in being critical in a substantial manner and that despite managing to unravel both the unexpected and

[518]Monstadt and Schramm (2017)

[519] KNA., Ref No. k.352.91 REP.

unwanted aspects of a technology, we will not be in a position to suggest any alternative vision.[520] To be able to locate agency both as technically embedded and as social-culturally constructed, we must borrow Edmund Husserl's philosophical injunction, *to the things themselves,* as echoed by Langdon Winner.[521] While the development of uneven 'networked infrastructure' systems in the Global South has been interpreted in the context of racial subjugation, the focus needs to shift more on trying to question the components of the models that necessitate certain outcomes. Infrastructure systems have an economic and political embedding. Since systems of provision of services, for example, water and sanitation, were carried out following the designs and plans from the North almost with no tinkering, it would be interesting to unravel the reasons for why their implementation alienate certain members of the society from the network.

D'Souza points out that the gravitational scheme was lifted from the landscapes of Britain and superimposed on the empire with great confidence and largely unmodified designs and procedures.[522] It follows, therefore, that the varying results of the systems are solely to be located in the failure by the engineers to appreciate that the metropole and colony constituted two distinct locations.[523] However, unevenness in access is not unique to the new frontiers of technological conquest. For example, Noyan Dinçkal'sIstanbul is a variegated supply system of fountains and pipes, which respectively reproduce the bifurcated nature of the city along economic lines.[524]In the case of Nairobi and most other Global South polities, I argued that the cost-recovery component that is embedded in large technical projects due to their capital-intensive nature is what redrew the access map. Service was provided on the principle of the customer's payability; hence, to a large extent, the skewed nature of connectivity reproduces itself due to economic or class premises though operating in an environment of autocratic colonial subjugation, it does not become a case of either one or the other. By operating on shoestring budgets, the colonial authorities in Nairobi concentrated infrastructure development in the white-dominated areas as a way of enhancing

[520] Hård (1993)

[521] Langdon (1980)

[522] D'Souza(2006), pp.621-628.

[523]Ibid.

[524]Dinçkal (2008)

the‘European good lifestyles’. Except for the government institutions, individuals had to apply for connectivity, but the cost of connection from the mains remained solely on the interested client. The ‘willing seller willing buyer’ approach, though not the main consideration throughout, meant that the socio-economic environment was a key determinant in the production of spatially dichotomized cities. Infrastructures acted as reinforcers of this division in an unintended manner, but in a consciously racially divided environment.

It justified to conclude that the faltering start of the first two decades of Nairobi’s emergence and growth auctioned it to western ideals of urban development. The entry of global institutions like the World Bank, which had an expanded mandate from its former IBRD, and the UNO through UNDP, WHO, and other agencies,meant the continuation of prescribed solutions that purported to consider local involvement yet perpetuated foreign ideals as conceived in Washington, New York, Brussels or London. The pattern of development adopted and the bracketing of indigenous systems of thought, survival and development as bordering on illegality militated against technological invention and innovation in the water and sanitation provision for Nairobi despite its continued existence as a water deficient city. In retrospect, it is not that the high-modernist and elitist planners in Nairobi did not see the potential in small approaches. Rather, the problem lies in the utopic and fantasist visualizations of the city. The indigene to the city is seen as a sore spot, warranting eradication, eviction or relocation. However, today most states take a more tacit approach to the question of the indigene in the urban space.

Perhaps ‘high modernism’ failed to acknowledge the multiplicity of actors within a system and unilaterally bequeathed science, as understood in the West, with the unquestionable ability to determine the future of society along a predetermined path. And in the break from the old, the machine acquired almost an idolised status as a non-human actant[525] in production without paying attention to the nature of the interactive process that is shrouded with cultural and political underpinnings. It is a case of either the machine having been humanised to disregard human agency in the making of history or a high modernism ideology having trusted the engineer, technocrat, shrewd

[525] See Latour in Harman (2009), p.15

business person or autocratic administrator with the ultimate role of determining the course of history through the planning and implementation of grandiose futuristic plans. By seeing infrastructures and technological artefacts as apolitical, modernist scholarship and implementers of LTSs saw most projects either hit an outright dead end or precipitate the perpetual crisis that engulfed cities such as Nairobi. The boomerang failure of the high-modernist thinking paved the way for the emergence of Schumacher's school of thought on planning and technologies of provisioning for livelihood sustenance. As revealed by most studies, the establishment of public services or utility companies in the North to attain some semblance of universalization was a process full of conflict and a long process that continued for close to a century.[526] Yet, Global South polities were expected to follow similar trajectories, but with a shorter time to come to fruition, perhaps with importation and implantation from the North being seen to anchor such optimism. The South was expected to absorb these 'best practices' and the power of the machine from the North through replication and adoption without adaptation, hybridization or even rejection. The propagation of the West as providing technological prototypes rather than templates for theGlobal South's 'leap forward' implied failure, social differentiation and a broadening gap between the elitist political and business class and the urban poor. Today, despite the vibrancy in small-scale approaches especially in urban informal spaces, the lack of a system of upscaling the technologies involved presents an almost similar narrative as that which befell the large projects that became 'white elephants'.

7.3.3. Obduracy, Temporality, and the notion of 'Home' and 'House'

Cities have traditionally been understood as socially dualized through the lenses of native versus immigrant settlers, age differentials, ethnicity, and education as polarized extremes.[527] For instance, Fanon draws the binary of a settler town built in stone and steel, and the native or Negro village, the 'Medina' as a town on its knees and wallowing in the mire.[528] Abu-Lughod stated that the major metropolis in almost every newly industrializing country is not a single unified city but two different cities

[526]See de Swaan (1988)

[527]See Mollenkopf and Castells (1993), pp.254-5.

[528] Fanon (1961), pp. 37-39.

physically juxtaposed but architecturally and socially distinct.[529] Freund indicates that the dual city in Africa is a widespread phenomenon necessitated by various historical and political factors in the face of European hegemonization.[530] Borrowing from Marcuse's challenge of the dual city thesis, where he argues that a complex reality exists in the contemporary city with multiplicity ('several different groups and quarters') rather than duality, I equally paint a picture of a multifaceted heterogeneous city in terms of technologies of social service provisioning for Nairobi and the inertia of centralized networks vis-à-vis the counter-active movements from below characteristics of the 'off-grid' localities. Rather than interpreting the urban as a case of two polarized extremes, as is the case in Mollenkopf and Castells'thesis, I argue that the large technical and centralized systems or rather the network city exists in complementarity with the devolved topologies that operate adjacently to the municipal networks. The 'small' technologies of provision do not compete or seek to undermine the 'big'. Instead, they complement each other as modalities that define the everyday experiences of people in cities like Nairobi as they mediate through the quest for livelihood sustenance. The technologies of provisioning are enculturalized to distinctly identify certain groups within certain contexts and the two co-exist side by side as they spatially and socially map out the urbanscape.

In Nairobi, for example, the water kiosks as small or fragmented modalities of water provisioning are wholly dependent on the municipal authority's network for their water supply,[531] whether legally connected from above or illegally connected from below. The spaghettization and use of porters that is characteristic of the informal areas, the boreholes that serve exclusive and expansive former colonial and European rich urban ranching citadels like Karen, the motorized water bowsers, trucks and pushcarts that service the intermittent middle income residential settlements, and the overhead storage tanks that augment the high-end suburbs of Nairobi represent the collage that is the waterscape for Nairobi alongside the septic tanks, cesspools, soak pits, pit-latrines, motorized exhaustersand hand-pulled carts that constitute the various modalities of sewerage management for Nairobi, and which complement the conventional urban

[529] Abu-Lughod (1965), p.420.

[530] See Freund (2007)

[531] Njoroge (1999)

municipal networked city model. It is at the interfaces between technology and people as users as well as co-producers that multi-directional configurations and reconfigurations occur to build these complementary systems of supply and access.

All in all, the acknowledgement of the obdurate technologies that connote either the indigene or the small and the complementarity arrangement with which heterogeneous socio-technical artefacts co-exist alongside each other to offer Nairobi stability in water and sanitation in the face of distress reveal not only questions of how the city as an urban space was conceived by the colonialists and postcolonial elites but also how people visualize it through their lived experiences. These lived experiences are not just socio-culturally drawn, they are also shaped by the techno-political arrangements, especially as defined by the bureaucratic instruments of administration that include urban management boards and municipal councils. Geographer Erik Swyngedouwhas observed that 'the political and the technical, the social and the natural become mobilized through socio-spatial arrangements that shape distinct geographies and landscapes; landscapes that celebrate the visions of the elite networks, reveal the scars suffered by the disempowered, and nurture the possibilities and dreams for alternative visions.'[532] How do these alternative visions contrast, clash or operate at a socio-cultural and techno-political equilibrium? The arrangement of pipes, grids, steel and concrete, wires and transistors, nuts and bolts or today's digital and virtual signals not only exist to solve practical or tangible issues in society, they also constitute certain intended or unintended political and economic arrangements loaded with representations of status, 'progress' and 'modernity' or other forms of symbolism. They shape socio-political and economic relations and operate within certain enabling frameworks, for example, in the form of the colonial or neo-colonial state, the autocratic or democratic state, the structuralist or welfarist and liberal state.

In a newspaper article of 19th January 2014, titled, *Africa's Poverty Contradictions and Dead Capital*, Bitange Ndemo – a technocrat and former senior government official who became the face of one of Kenya's most elaborate plan for a 'fantasy city', that is, Konza City – observed that, '…it is why we are building haphazardly to the extent that we may never benefit from common infrastructure like energy, water, and sewerage

[532]Swyngedouw (2007), p.24.

that minimizes cost and ensures disease is kept at bay'.[533] What is striking in this kind of thinking, more than a century since the birth of Nairobi, is not the enormous faith that the technocrats and political elites continue to place in the highly conceptualized central systems of provision and rationalized urban topologies, but the obduracy of so-called 'haphazard' development. The 'rational' and 'organic' city develop concurrently as long as exclusionary visions continue to be pursued. Revisiting colonialism, it is right to state that Nairobi was envisioned as a 'white man's peculiar creation',[534] one where 'Africans could only be temporary residents of the town, coming in only to minister to the white man's needs as labourers and eventually returning to their rural homes'.[535] Through restrictive legal and policy instruments, Africans were prohibited from developing a permanent sense of settlement in urban areas. Conversations with most Nairobians bring to the fore a sense of temporality that has been perpetuated over time whereby even those who own urban houses come to consider themselves as 'sojourners' with 'houses' rather than 'homes'.[536] How does this notion of 'house' and 'home' as reinforced by either local cultural values of home (upcountry or rural) or exclusionary urban techno-economic and political ideologies impact on the infrastructural techno-scape as we pursue questions of meaning and effect?

Because of the exclusionary land auctions, most initial African residential areas in the urban areas were outside the 'city proper' and were largely self-construction efforts.[537]As discussed in this thesis, self-constructed sites like Kibera serve as centres for either bottoms-up innovative ventures of provisioning or reveal the persistency of the indigenous people. The aspect of 'self-construction', 'do it yourself' or Andrew Hake's characterization of Nairobi as a 'self-help city',[538] I argue, reveals the 'human or user agency' in technology. However, this user agency can easily be frustrated by overbearing the administrative organs of the state. For instance, in the 1960s and early 1970s, the Mathare Valley – from where Andrew Hake as a church and social developer directly interacted with people, leading to his aforementioned publication – witnessed

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[533]Ndemo*Sunday Nation*newspaper, 14th January 2014.

[534] See Parnell, 'Creating Racial Privilege,' p. 471, and Swanson, 'Urban Origins of Separate Development,' p. 31.

[535] Rich (1978) cited by Murunga in Salm and Falola (2005), pp.98-130.

[536]Osita in Salm and Falola (2005), pp.73-129.

[537]Ibid.

[538] Hake (1977)

asurge in local bottom-linked initiatives of land appropriation through communal land-buying companies and, at the same time,an embracing of technical ventures of provision through self-help schemes. Despite the potency of such initiatives, the autocratic state either directly suppressed them through a system of policy standards or tacit 'slum clearance', evictions or budgetary constrictions. One tragedy that I notedin the urban infrastructure management is the lack of people's direct participation in technological decision-making in most of the Global South if the example of Nairobi can be assumed to reflect the case of most former colonies. In *City Water, City Life*, Smith discusses what he characterizes as 'water and the infrastructure of ideas in urbanizing Philadelphia, Boston and Chicago' and what comes out clearly is the overwhelming role played by ordinary and powerful individuals alike in deciding on the ideal technologies of supplying themselves with water.[539]

The emergence of political pluralism in Kenya from 1991 against the backdrop of the weaknesses of the 'appropriate technology' rhetoric and the augmentation of liberal market ideals in the management of infrastructure systems provided a new impetus for individual and communal agency in technologies of water and sanitation provisioning for Nairobi. Areas that had, for long, operated as 'blank and blind' spots have witnessed massive grassroots mobilization, realizing their innovative potential. By partnering with various financial state and foreign actors, Nairobi has seen the emergence of remarkable technologies such as the bio-centre approach. Also, the standpipe and kiosk systems of supply for water are slowly being incorporated into the 'formal' arrangement as indicated in this thesis through the 'Informal Settlements department' of the NCWSC.

7.4 Reflecting on Further Research

Achille Mbembe correctly notes that although innovation in urban development often occurs in the South, its networks are not simply North-South, but also South-East-North-South and South-South, amongst many other flows.[540] While the North-South paradigm dominates most technological discourses towards developing scholarship on technology, for example, the history of technology, which is my primary concern, it

[539] Smith (2013)

[540] Mbembe (2012), pp.8-14

will be imperative for inclusive narratives that acknowledge multidirectional flows of knowledge to be developed. In the social discourses of the metropolis in the South, the approach is basically an asymmetrical binary of European or White (North) and indigenes. However, the truth is that these localities constitute multiple groups of people. For example, the history of Nairobi is interwoven into that of many local and immigrant groups, which include Asians (Indians), Africans of Nubian origin from Sudan brought in during the occupation as military porters and soldiers, Somalis and Arabs or Swahilis from the coast of Kenya. It is impossible to discuss Nairobi through the tension between Africans and Europeans alone. From the pioneering period, Asians have had a strong imprint on the economic, social and political texture of Nairobi and only a multi-pronged approach can be as revealing as possible. This applies to virtually allofthe-Global South cities and, by extension, the Global North as humans transiting is as old as humanity. More inclusionary methodologies, as well as theoretical frameworks, need to be adopted towards writing a global HOT.

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APPENDICES

Appendix 1.

CURRICULUM VITAE

ACADEMIC QUALIFICATIONS

PhD in History of Technology | 2014 to date

Technische Universität Darmstadt, Germany

Title of Dissertation: *In the Technological Footprints of Urbanity: A socio-political history of Water and Sanitation in Nairobi, 1899 to 2015.*

Master of Arts (MA) in History | 2008 - 2012

Maseno University, Kenya

Title of Dissertation: *The Role of Government in the Marginalization ofthe UrbanPoor: A Case of Kibera Informal Settlement, 1963 to 2002.*

Bachelor of Education (Arts) | 2002 - 2006

Maseno University, Kenya

Achievement :*First Class Honors*

Specialization : History/Government and Kiswahili

RESEARCH ACTIVITIES/EXPERIENCE

1. Archival Research in Nairobi Kenya (Kenya National archives and Macmillan Library); British National Library at Kew Richmond, London; and Bodleaian Library Oxford — as part of the PhD research between March 2015 and September 2016 intermittently. This coupled with document/desk-top/library research at SOAS and Institute of Civil Engineers (ICE) London.
2. Field Research in Kibera, Mathare, Kariobangi and Ruiru in Kenya for a period of three months starting July 2016. Mostly conducted key informant interviews, Focus Group Discussions and field observatory methods.
3. Archival and Field research at Kenya National Archives in Nairobi and Kibera for the MA project between 2009 and 2010.

WORK EXPERIENCE

Technische Universität Darmstadt, Germany
Research Assistant | Oct 2017- April 2018

Maseno University, Maseno, Kenya | Department of History and Archaeology
Tutorial Fellow | Nov 2012 - Nov 2014

- Teaching/Lecturing, Examining, Research

Maseno University, Maseno, Kenya | Department of History and Archaeology
Graduate Assistant | June 2009 - June 2012.

Nairobi Muslim Academy, Nairobi, Kenya
Teacher of Kiswahili, History and Government | January 2007 - August 2008

- Served as Head of Humanities Department and Curriculum Co-ordinator

MEMBERSHIP TO PROFESSIONAL AND ACADEMIC/RESEARCH NETWORKS

Graduate School for Urban Studies (URBAN grad), Darmstadt University of Technology
British Institute in Eastern Africa (BIEA)
Kenya University Staff Union
West Kenya Historical Association
Kenya Teachers Service Commission

CONFERENCES AND SEMINARS

October 11-14, 2018: Society of History of Technology (SHOT) Conference at St. Louis, Missouri, USA- presented paper in a plenary on "Infrastructure in Africa: Local Knowledge and Technological Know-How".

June 22 - 26, 2016: Society of History of Technology (SHOT) Conference at Tembusu College, University of Singapore- presented paper in a plenary on Imperialism, Technology and Culture.

January 15 - 17, 2016: Conference on water regimes in the Global South, organized in New Delhi, India by the Centre for Policy Research (CRP) - presented co-authored paper on the evolution of Nairobi's Water infrastructure systems questioning a networked city concept and technology transfer.

July 8 - 10, 2015: ECAS 2015 6th European Conference on African Studies, Paris, on Collective Mobilizations in Africa: Contestation, resistance and revolt- presented paper on the Nubians struggle for citizenship in Kibera, Nairobi and the contestation for land.

PUBLICATIONS

Chapters in Edited Volumes

Akallah, J. A (2013). "The Second Kibaki Era; 2007-2013: Seeking Stability within Turbulent Waters" in W. R. Ochieng (ed); *A History of Independent Kenya: A celebration of 50 years of Independence,* Kisumu, Lake Publishers and Stationers Limited.

Akallah, J. A. (2012). "The Luhya Politics" in Ochieng, W. R ;Cokumu, P. O ; Akallah, J. A. (ed); *A History of Western Kenya in the 20th and 21st Centuries*, Kisumu, Lake Publishers and Stationers Limited.

Chapter under review

Akallah, J. A.: Infrastructure, Race and Socio-spatial differentiation: Unbundling Nairobi's Water System, 1899 to 1939, in Monstadt J.; de Bercegol R.; Bon B. (forthcoming), *Translating the networked city: Urban Infrastructures in Nairobi and Dar Es Salaam*, Routledge.

Conference Proceedings

Akallah, J. A.; de Bercegol R.; Kanini Wamuchiru E. (2016), *(Re) Producing Engineering: Retracing Nairobi's Water Supply Practices*, Centre for Policy Research, Delhi, India
http://www.cprindia.org/sites/default/files/events/Conference%20Proceedings%20Water%20Regimes.pdf.